Service Manual

Quartz PLL **DIRECT DRIVE**
FULL AUTOMATIC TURNTABLE

PL-630

PIONEER®

MODEL PL-630 COMES IN FIVE VERSIONS DISTINGUISHED AS FOLLOWS:

Type	Voltage	Remarks
KCT	120V only	Canada model (Without cartridge)
KUT	120V only	U.S.A. model (Without cartridge)
HGT	220V – 240V	Europe or Oceania model (Without cartridge)
ST	110V – 120V, 220V – 240V (Switchable)	General export model (Without cartridge)
S/G	110V – 120V, 220V – 240V (Switchable)	U.S. Military model (Within cartridge)

- **This service manual is applicable to the PL-630/KCT, KUT. For servicing of the other types please refer to the additional service manuals.**

CONTENTS

1. SPECIFICATIONS 3
2. PANEL FACILITIES 4
3. DISASSEMBLY 6
4. PART LOCATION 8
5. SCHEMATIC DIAGRAMS, P.C. BOARD PATTERNS AND PARTS LIST
   - 5.1 Schematic Diagram 9
   - 5.2 Control (A) Assembly (PWX-035) 11
   - 5.3 P.C. Board Connection Diagram 12
   - 5.4 Control (B) Assembly (XWX-007) 15
   - 5.5 Switch Assembly (XWX-008) and Lamp Assembly (XWX-009) 15
   - 5.6 Tonearm Drive Assembly (PWX-027) 16
   - 5.7 Power Supply Assembly 17
   - 5.8 Oscillator Assembly (PWX-022) 17
   - 5.9 Drive Control Assembly (PWG-017) 18

   EXPLODED VIEW
   - 6.1 Outer Parts 19
   - 6.2 Cabinet 21
   - 6.3 Tonearm (Arm Base) 23
   - 6.4 Under Base 25
   - 6.5 D. D. Motor (PXM-067) 26
   - 6.6 Packing 27
7. DESCRIPTION OF OPERATION
   - 7.1 Mechanical Section 29
   - 7.2 Control Section (Electrical Section) 31
   - 7.3 Actual Operation (17cm record) 34
   - 7.4 Actual Operation of Mechanical Section . . . 35
8. ADJUSTMENT 36
9. D.D. MOTOR CIRCUIT DESCRIPTIONS AND TROUBLE SHOOTING
   - 9.1 Block Diagram 39
   - 9.2 Motor Operation 41
   - 9.3 Operation of The PD1003 IC (Oscillator Stage) 43
   - 9.4 Operation of The PA2004 IC (Comparator Control) 43
   - 9.5 Operation of The PA2005 IC (Drive Control) 43
   - 9.6 Trouble Shooting Chart 48

1. SPECIFICATIONS

Motor and Turntable

Drive System ..... Direct-drive
Motor ..... Quartz PLL Hall motor
Turntable Platter ..... 330mm diam. aluminum alloy die-cast
Inertial Mass ..... 340kg-cm^2 (including platter mat mass)
Speeds ..... 33-1/3 and 45rpm
Speed Control Range ..... ±6%
Wow and Flutter ..... Less than 0.025% (WRMS)
Signal-to-Noise Ratio ..... More than 75dB (DIN-B)
(with Pioneer cartridge model PC-600)

Rotational Characteristics

Build-up Time ..... Within 90° rotation at 33-1/3 rpm
Speed Deviation ..... Less than 0.002%
Speed vs. Load Characteristics ... Stable up to 200 grams drag load
Speed Drift ..... Less than 0.00008%/h at 33-1/3rpm
Less than 0.00003%/degree temp. change at 33-1/3rpm

Tonearm

Type ..... Static-balance type, S-shaped pipe arm
Effective Arm Length 237mm
Overhang 15mm
Usable Cartridge Weight ..... 4g (min.) to 12.5g (max.)
(For cartridge weights over 8.5 grams, attach the sub weight)
Arm Height Adjust Range ..... ±3mm

Subfunctions

Auto lead-in
Auto-return
Auto cut
Quick repeat
Quick play
Quick stop
Anti-skating force control
Stylus pressure direct-readout counterweight
Arm height adjusting device
Cueing device
Pitch meter
Free stop hinges

NOTE:
Specifications and design subject to possible modification without notice, due to improvements.

Semiconductors

ICs 7
Transisotrs 17
Diodes 9
Hall Elements 3
LED 10
Photo Transistors 2
CdS 1

Miscellaneous

Power Requirements ..... AC 120V 60Hz
Power Consumption 22W
Dimensions ..... 470(W) x 148(H) x 418(D)mm
18-1/2(W) x 5-13/16(H) x 16-7/16(D) in.
Weight 12kg/26lb 7oz

Accessories

EP adaptor 1
Overhang gauge 1
Screwdriver 1
Sub weight 1
Cartridge mounting screws 6
Cartridge mounting nuts 2
Cartridge mounting washers 2
Operating instructions 1

2. PANEL FACILITIES

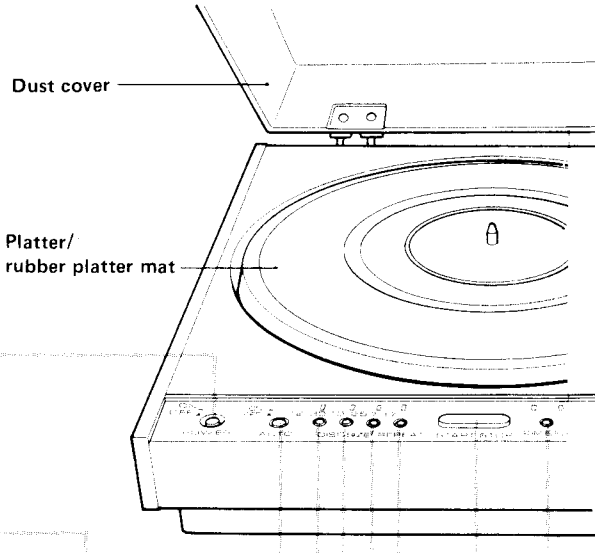
POWER SWITCH

ON . . . . . Press this switch and the power will come on. The ARM ELEVATION switch indicator (▼) and SPEED switch indicator (45 or 33) will both light up.

OFF . . . . The power will be cut off when this switch is released, and the indicators will go off.

NOTES:

- *The platter will not rotate when the tonearm is on the arm-rest even when the POWER switch is set to ON.*
- *Always set the POWER switch to OFF when you do not intend to use your turntable.*



AUTO SWITCH

ON . . . . . Select this position for auto play (refer to page 10). When this switch is pushed, the DISC SIZE indicator (12"30) lights up.

OFF . . . . . When this switch is released, the auto mechanism is disengaged, and all the operations can be performed by hand. Set the switch to this position when playing a record whose size is not standardized since the tonearm will otherwise return to the arm rest automatically. When this switch is set to OFF, you will not be able to perform auto play and repeat play operations. For record play, move the tonearm manually.

NOTE:

- *When the AUTO switch is set to OFF, the DISC SIZE and REPEAT switch indicators will not light up even if the respective switches are pushed.*

DISC SIZE SWITCHES

Press the switch that corresponds to the size of the record you want to hear for auto play operations. The corresponding switch indicator will then light up.

12"30 . . . . . For 30cm records

10"25 . . . . . For 25cm records

7"17. . . . . For 17cm records

NOTES:

- *The 12"30 switch is selected automatically when the POWER switch is set to ON.*
- *These switches will not work if depressed when the tonearm is moving (auto return).*

REPEAT SWITCH

Press this switch for repeat play. When pressed, the indicator will light up, and the record will be played again (refer to page 11 for further details on repeat play). Press this switch again to release it. The indicator will go off and the repeat play function will be released.

NOTES:

- *This switch cannot be operated even if depressed while the tonearm is moving out of contact with the record.*
- *There will be no repeat play when the AUTO switch is set to OFF.*

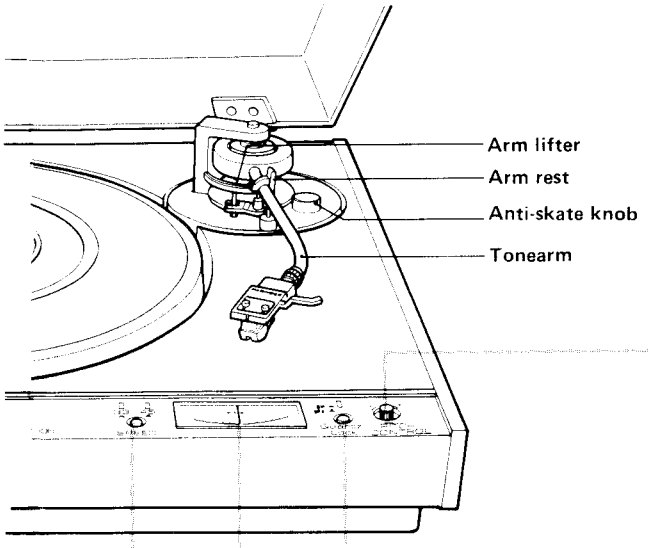
START/STOP SWITCH

Press this switch for auto play. The platter will start to rotate, the tonearm will automatically move over to the edge of the record and play will begin (auto lead-in).

If this switch is pressed during play, the tonearm will automatically return to the arm rest, the platter will stop rotating and play will be suspended (auto cut).

NOTES:

- *This switch's STOP function has no effect on tonearm movement unless the tonearm is in contact with the record.*
- *This switch cannot be selected when the AUTO switch is set to OFF.*



PITCH CONTROL KNOB

If this knob is rotated with the Quartz LOCK switch at OFF, you will be able to increase or decrease the speed of the platter in respect to its rating. When the knob is rotated in the "+" direction, the platter will rotate faster, and when rotated in the "−" direction, it will rotate slower than its rating. The PITCH meter can be observed to check the amount of speed increase or decrease (up to 6% in either case).

QUARTZ LOCK SWITCH

ON . . . . . When this switch is pressed, the Quartz PLL circuitry is actuated and the indicator will light up. The switch is usually kept at this position. The platter will be accurately locked to the rotational speed corresponding to the position of the SPEED switch.

OFF . . . . When this switch is released, the Quartz PLL circuitry is disengaged, the PITCH meter lights up and the indicator goes off. Set the switch to this position for instrumental and other performances in accordance with the record being played.

SPEED SWITCH

33 . . . . . Set the switch to this position when playing a 33-1/3rpm record such as an LP. When it is depressed, the 33 indicator lights up, and the platter rotates at a speed of 33-1/3rpm.

45 . . . . . Set the switch to this position when playing a 45rpm record like an EP. When it is depressed, the 45 indicator lights up, and the platter rotates at a speed of 45rpm.

PITCH METER

When the Quartz LOCK switch is set to OFF, the PITCH meter lamp will light up, and the variation in the rotational speed of the platter in respect to its rating (33-1/3 or 45rpm) can be read out on the meter.

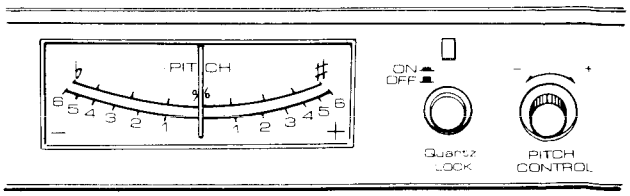
ARM ELEVATION SWITCH

Use this switch to interrupt play temporarily or to perform manual play.

When the DOWN (▼) indicator lights up, the tonearm will descend and when the UP (▼) indicator lights up, the tonearm will rise. These two operations will be performed alternately every time the switch is pressed.

NOTES:

- *When the POWER switch is set to ON, the tonearm will descend and the DOWN indicator lights up.*
- *Always set the switch to DOWN for auto play.*
- *When the switch is at UP, the auto return cancelling mechanism is actuated and so there will be no auto return or auto cut.*



3. DISASSEMBLY

- **Cabinet and Arm Base**

1. Remove the 4 mounting screws retaining the upper cover.
2. Remove the AC mains connector.
3. Remove the output cord connector.
4. Remove the screws retaining the feet.
5. Move the arm to the vicinity of the center shaft.
6. Lift the cabinet from the rear side. As the cord is clamped, remove the cabinet while releasing the clamp.
7. Undo the 4 screws retaining the arm base, and then remove the arm base.

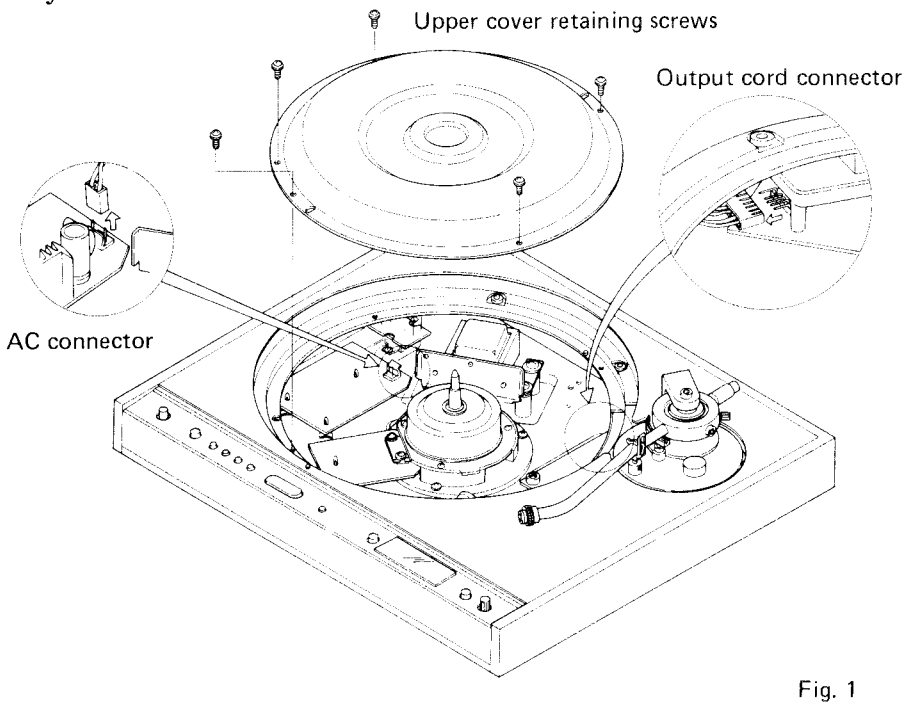


Fig. 1

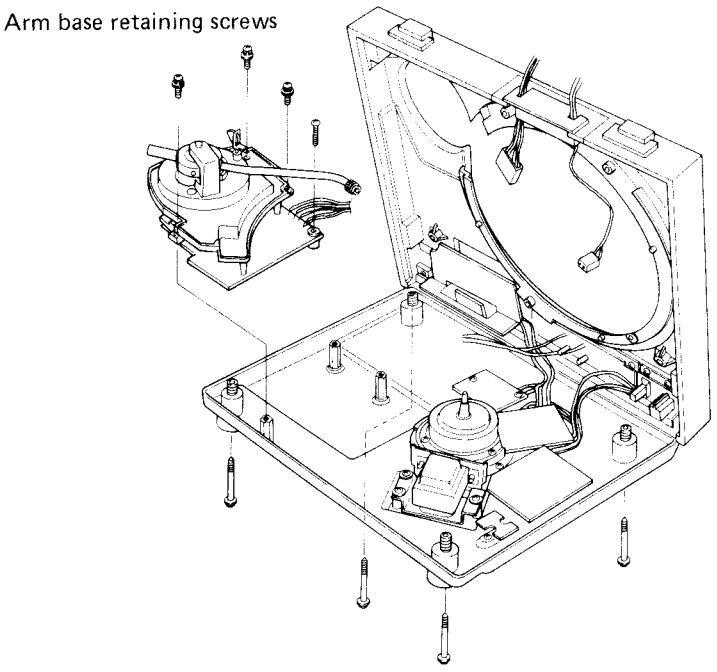


Fig. 2

- Tonearm

1. Loosen the mounting screws holding PU plates A and B which are fitted to the arm shaft, and remove the PU plates.
2. Undo the 2 screws retaining the tone arm, and then remove the tone arm.

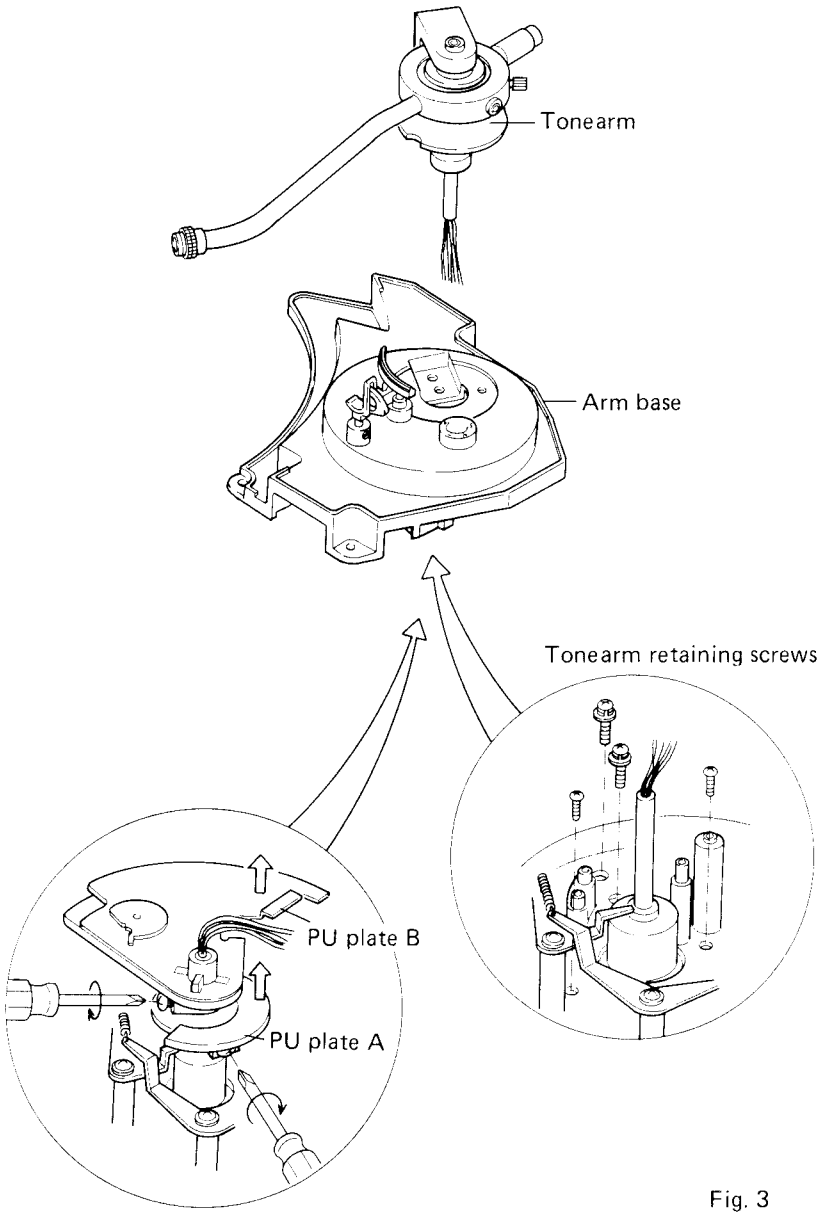
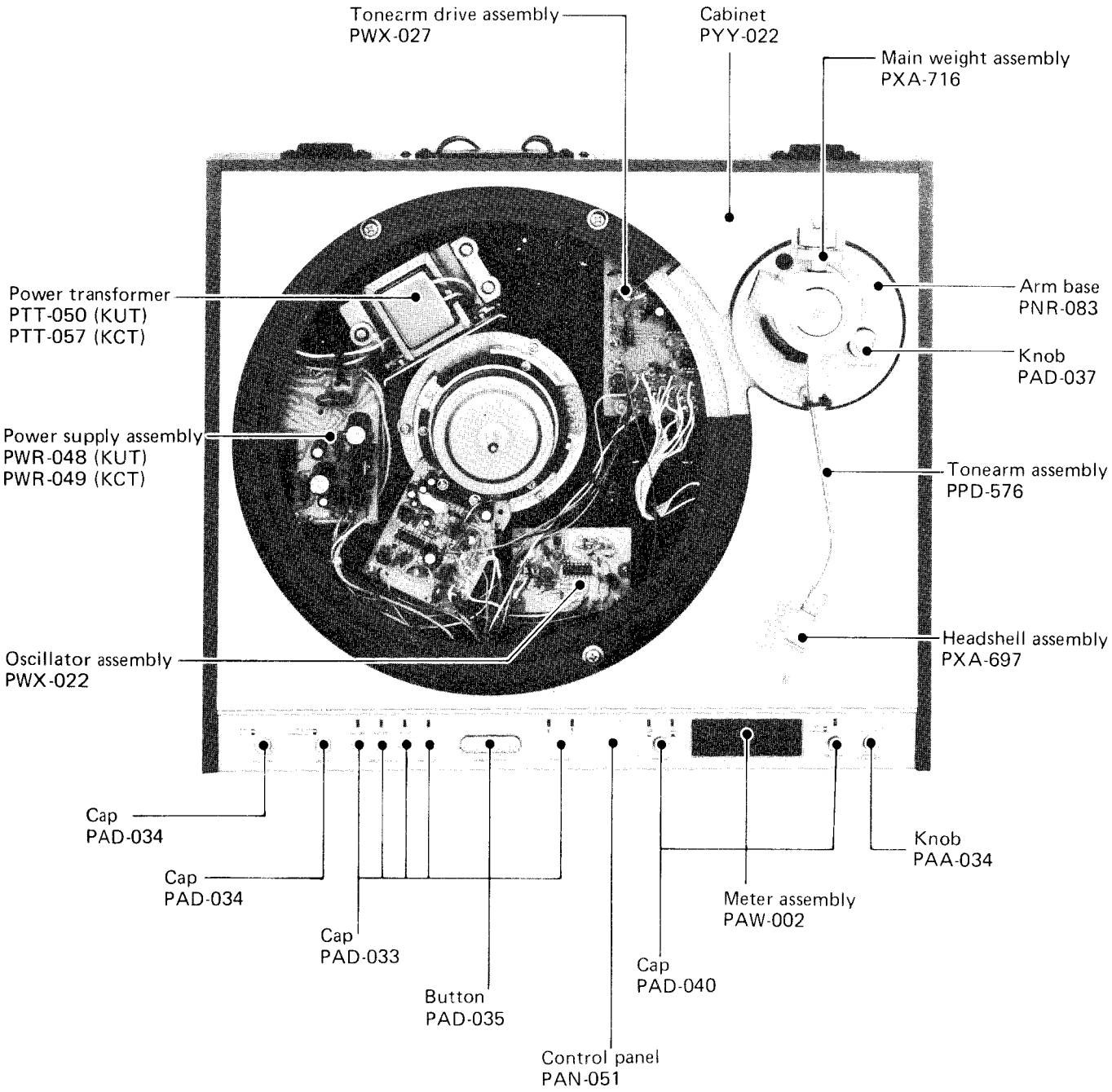


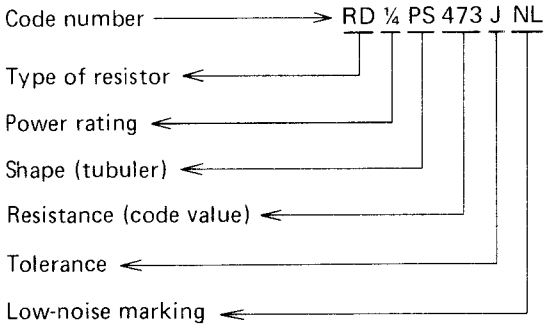
Fig. 3

4. PART LOCATION



RESISTANCE VALUE CODES

Code numbers of resistors used in Pioneer equipment are expressed in the following way:—



Furthermore, in the list of parts found in the Service Manual, the resistance (code value) part of the above code number is expressed as □□□ or □□□□.

Resistors included in the Service Manual list of parts

↓

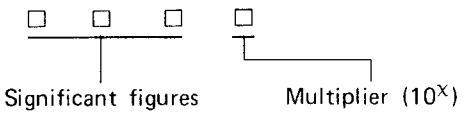
Ex. RD ¼ PS □□□ JNL

When ordering resistor components, first ascertain the actual resistance value from the circuit diagram, and then convert it into code no. form as shown in the following examples.

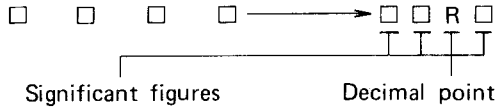
For further details on code numbers, refer to "Tuning Fork" VOL. 1.

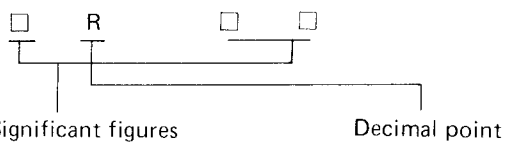
Ex. 1 For □□□□ Codes

* **General resistors**



* **Resistors with fractional values**



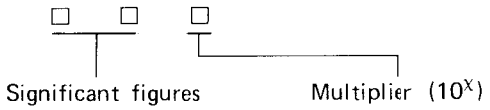


Ex. 1

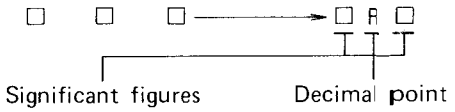
Nominal resistance (Ω)	Significant figure (three figures)	Multiplier (10^X)	Resistance value code
5.1	510	.....	5R10
5.62	562	.....	5R62
10	100	.....	10R0
22.5	225	.....	22R5
110	110	$\times 10^0$	1100
1k (1000)	100	$\times 10^1$	1001
1.56k (1560)	156	$\times 10^1$	1561
10k (10000)	100	$\times 10^2$	1002
33.6k (33600)	336	$\times 10^2$	3362
112k (112000)	112	$\times 10^3$	1123
1M (1000000)	100	$\times 10^4$	1004
1.56M (1560000)	156	$\times 10^4$	1564

Ex. 2 For □□□ Codes

* **General resistors**



* **Resistors with fractional values**

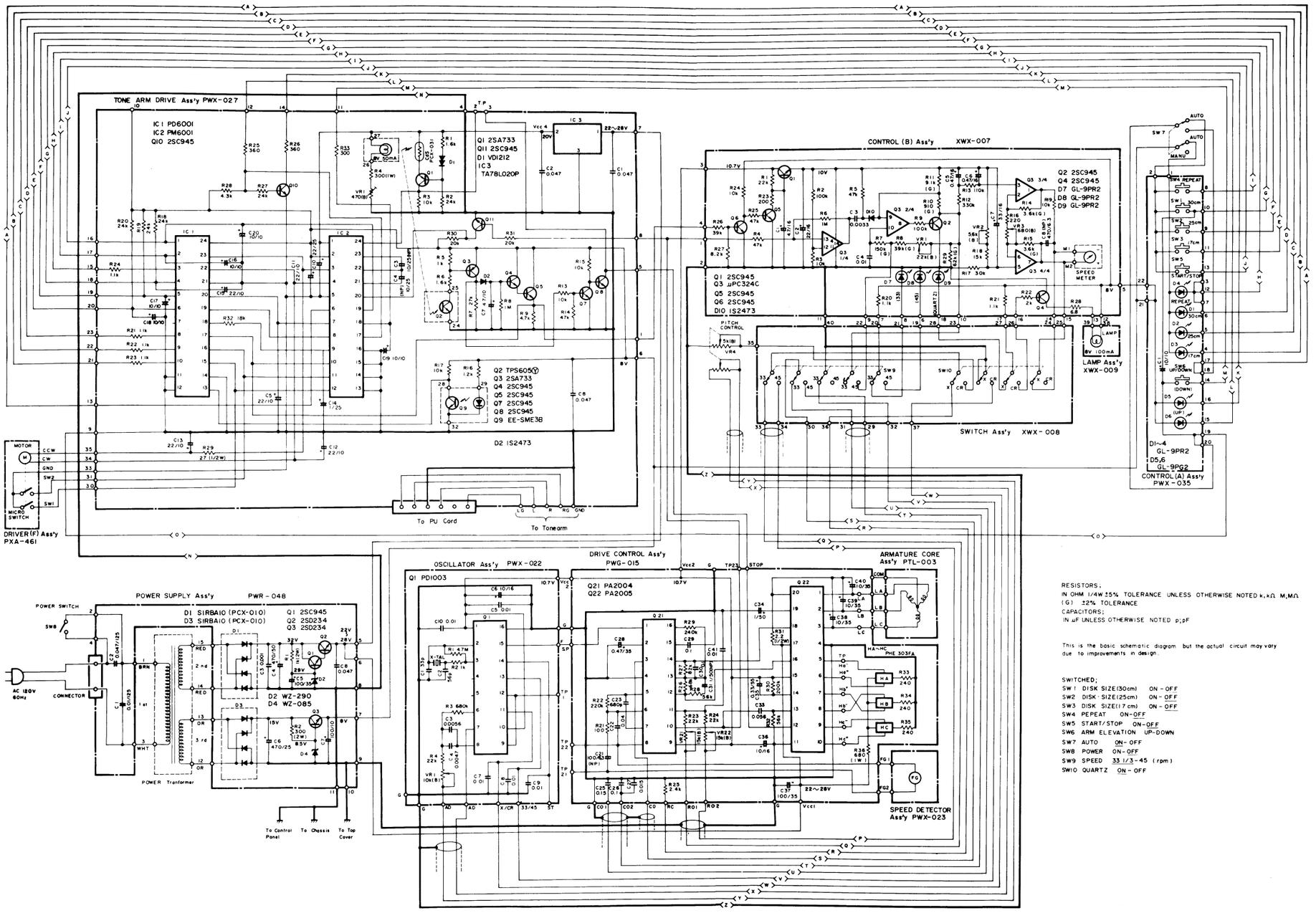


Ex. 2

Nominal resistance (Ω)	Significant figure (two figures)	Multiplier (10^X)	Resistance value code
0.5	05	.....	0R5
1.5	15	.....	1R5
1	01	$\times 10^0$	010
22	22	$\times 10^0$	220
330	33	$\times 10^1$	331
1k (1000)	10	$\times 10^2$	102
5.6k (5600)	56	$\times 10^3$	562
68k (68000)	68	$\times 10^3$	683
820k (820000)	82	$\times 10^4$	824
1M (1000000)	10	$\times 10^5$	105
2.2M (2200000)	22	$\times 10^5$	225

5. SCHEMATIC DIAGRAMS P.C. BOARD PATTERNS AND PARTS LIST

5.1 SCHEMATIC DIAGRAM



RESISTORS;
IN OHM 1/4W ±5% TOLERANCE UNLESS OTHERWISE NOTED k,kΩ M,MΩ
(G) ±2% TOLERANCE
CAPACITORS;
IN μF UNLESS OTHERWISE NOTED p;pF

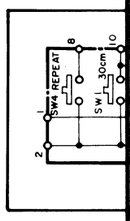
This is the basic schematic diagram but the actual circuit may vary due to improvements in design.

SWITCHED;
SW1 DISK SIZE(30cm) ON - OFF
SW2 DISK SIZE(25cm) ON - OFF
SW3 DISK SIZE(17cm) ON - OFF
SW4 PEPEAT ON-OFF
SW5 START/STOP ON-OFF
SW6 ARM ELEVATION UP-DOWN
SW7 AUTO ON - OFF
SW8 POWER ON - OFF
SW9 SPEED 33 1/3 - 45 (rpm)
SW10 QUARTZ ON - OFF

Miscellaneous P

Part No.
PWX-027
PWX-035
XWX-007
XWX-008
XWX-009
PWG-017
PWX-022
PTL-003
PWR-049
PWR-048
PTT-057
PTT-050
PSA-002

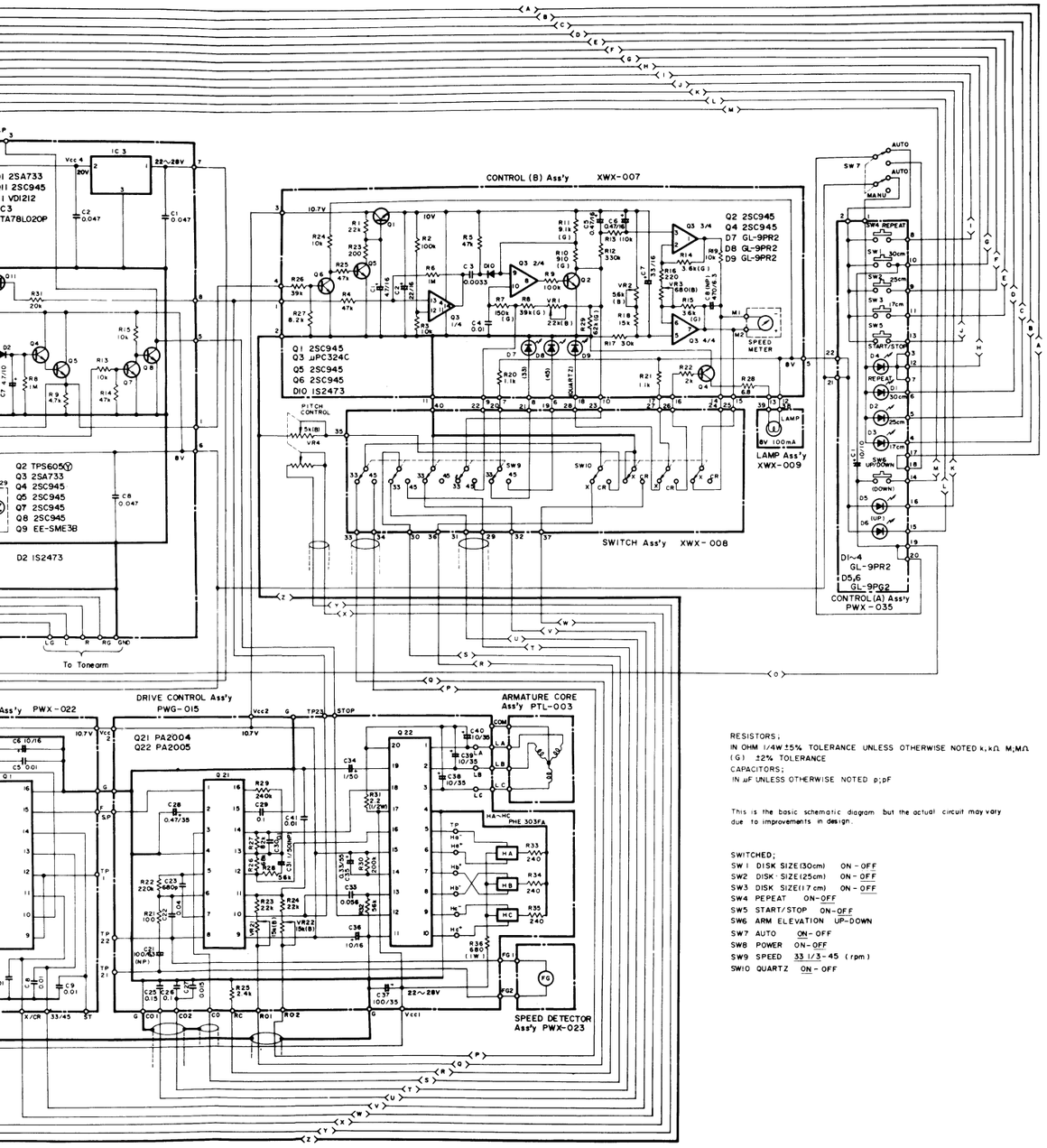
5.2 CONTRO



Parts List of C

Part No.
PSG-009
CEA 100P 10
GL-9PR2
GL-9PG2

PATTERNS



RESISTORS;
IN OHM 1/4W ±5% TOLERANCE UNLESS OTHERWISE NOTED k,kΩ M;MΩ
(G) ±2% TOLERANCE
CAPACITORS;
IN μF UNLESS OTHERWISE NOTED p;pF

This is the basic schematic diagram but the actual circuit may vary due to improvements in design.

SWITCHED;
SW1 DISK SIZE(30cm) ON - OFF
SW2 DISK SIZE(25cm) ON - OFF
SW3 DISK SIZE(17cm) ON - OFF
SW4 PEPEAT ON-OFF
SW5 START/STOP ON-OFF
SW6 ARM ELEVATION UP-DOWN
SW7 AUTO ON - OFF
SW8 POWER ON-OFF
SW9 SPEED 33 1/3 - 45 (rpm)
SW10 QUARTZ ON - OFF

NOTES:

- *When ordering resistors, first convert resistance values into code form as shown in the following examples.*

Ex. 1 When there are 2 effective digits (any digit apart from 0), such as 560 ohm and 47k ohm (tolerance is shown by J = 5%, and K = 10%).

560Ω	*56 x 10¹*	*561*	*RD¼PS 5 6 1 J*
47kΩ	*47 x 10³*	*473*	*RD¼PS 4 7 3 J*
0.5Ω	*0R5*		*RN2H 0 R 5 K*
1Ω	*010*		*RSIP 0 1 0 K*

Ex. 2 When there are 3 effective digits (such as in high precision metal film resistors).

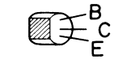
5.62kΩ	*562 x 10¹*	*5621*	*RN¼SR 5 6 2 1 F*

Miscellaneous Part

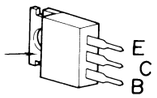
Part No.	Description
PWX-027	Tonearm drive assembly
PWX-035	Control (A) assembly
XWX-007	Control (B) assembly
XWX-008	Switch assembly
XWX-009	Lamp assembly
PWG-017	Drive control assembly
PWX-022	Oscillator assembly
PTL-003	Armature core assembly
PWR-049	Power supply assembly (KCT)
PWR-048	Power supply assembly (KUT)
PTT-057	Power transformer (KCT)
PTT-050	Power transformer (KCU)
PSA-002	Power switch

External Appearances of Transistors

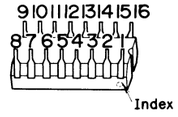
2SC945
2SA733



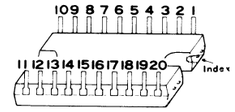
2SD234



PA2004
PD1003

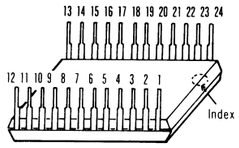


PA2005

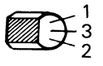


TPS605

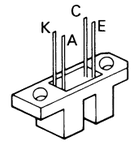
PD6001
PM6001



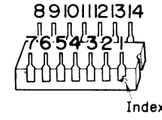
TA78L020P



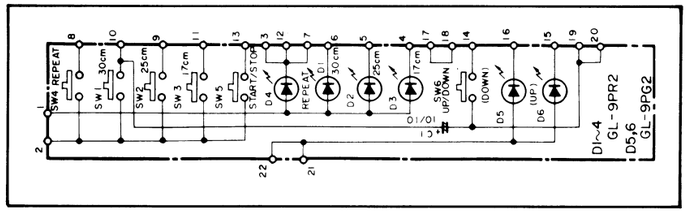
EE-SM3B



μPC324



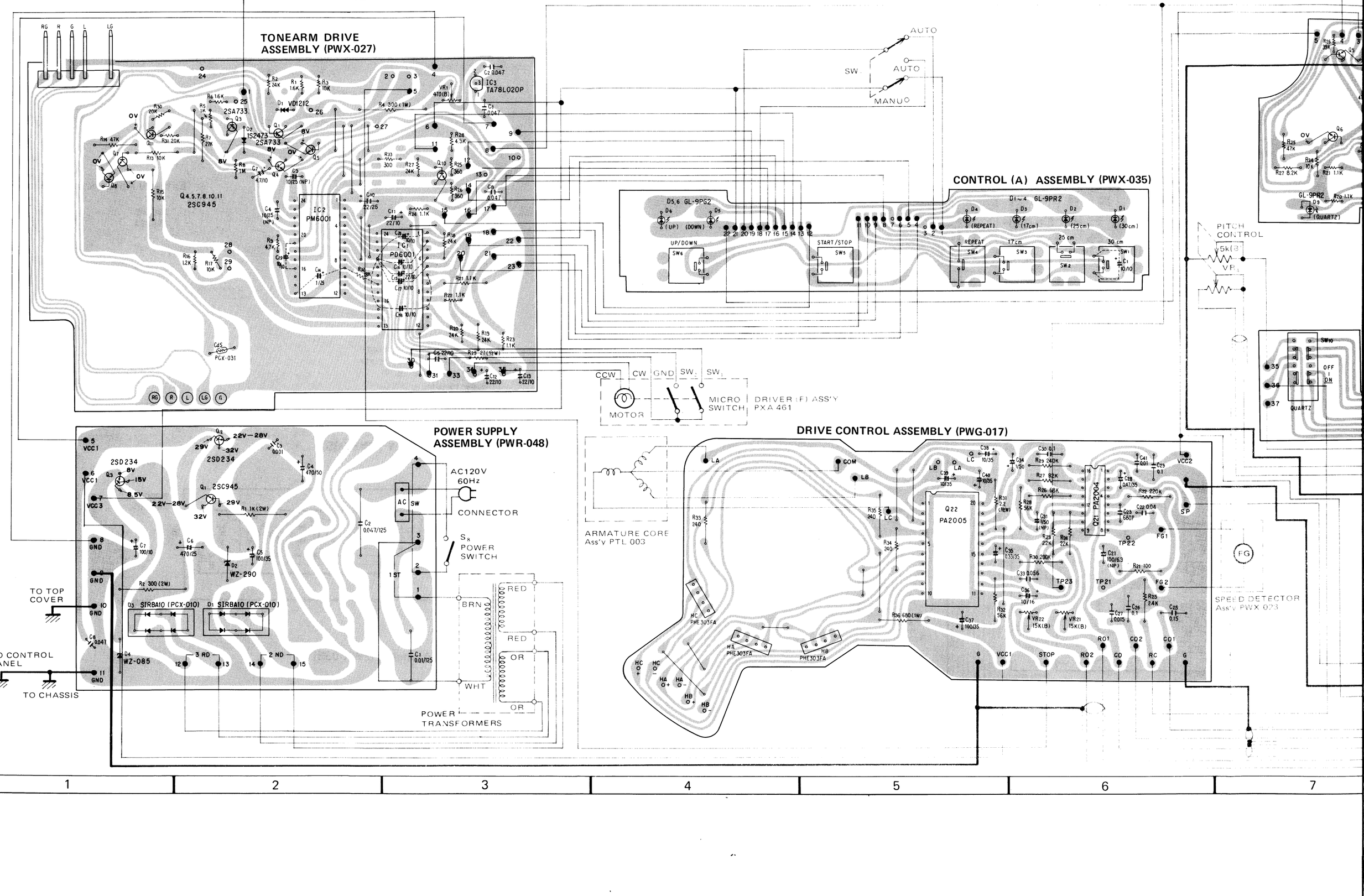
5.2 CONTROL (A) ASSEMBLY (PWX-035)



Parts List of Control (A) Assembly (PWX-035)

Part No.	Symbol & Description	
PSG-009	SW1—SW6	Switch
CEA 100P 10	C1	
GL-9PR2	D1—D4	(without assembly)
GL-9PG2	D5, D6	(without assembly)

5.3 P.C. BOARD CONNECTION DIAGRAM



Body: wd

4	5	6	7	8	9

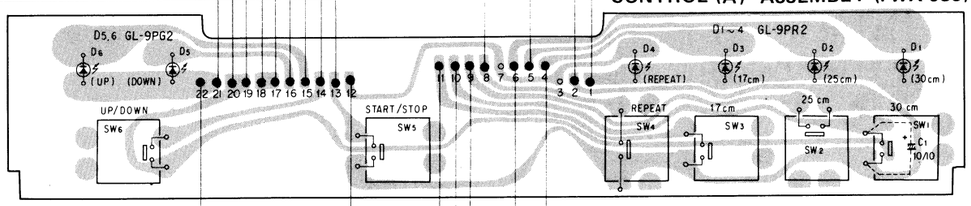
A

B

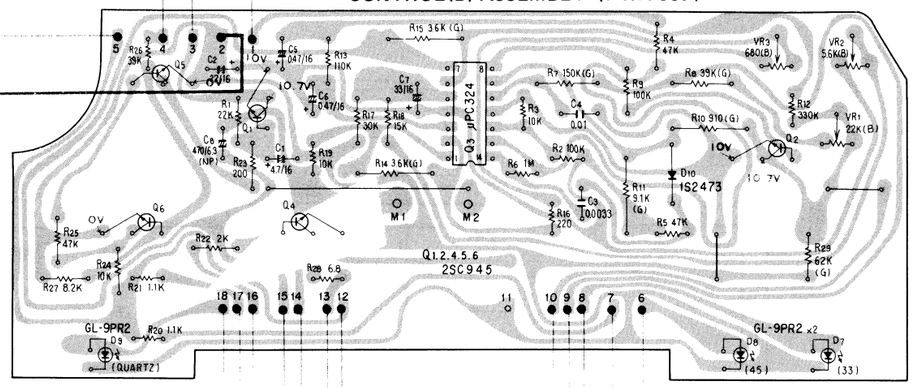
C

D

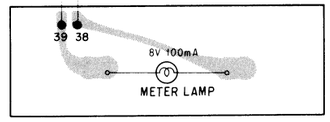
CONTROL (A) ASSEMBLY (PWX-035)



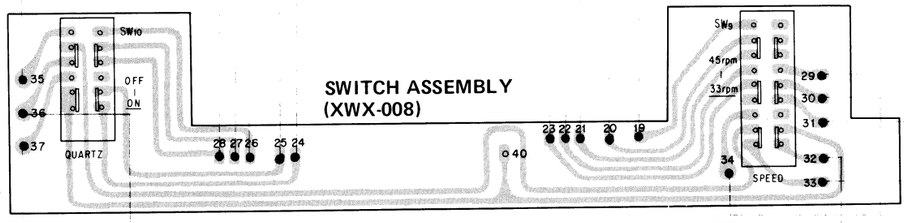
CONTROL(B) ASSEMBLY (XWX-007)



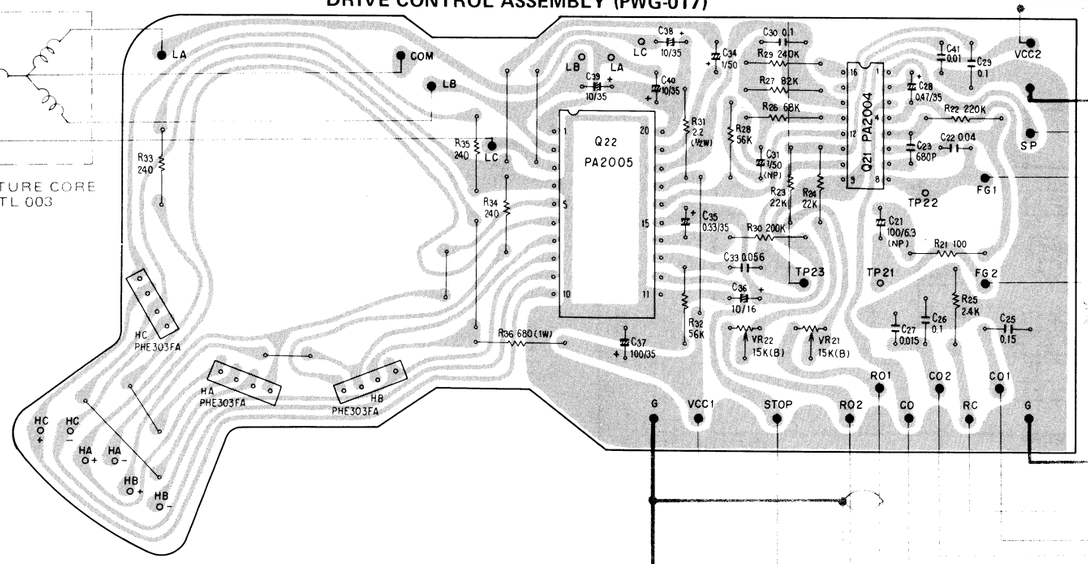
LAMP ASSEMBLY (XWX-009)



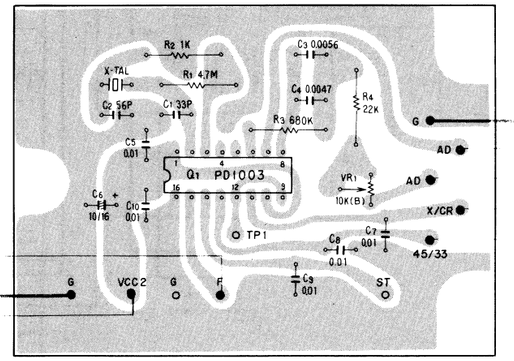
SWITCH ASSEMBLY (XWX-008)



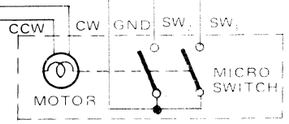
DRIVE CONTROL ASSEMBLY (PWG-017)



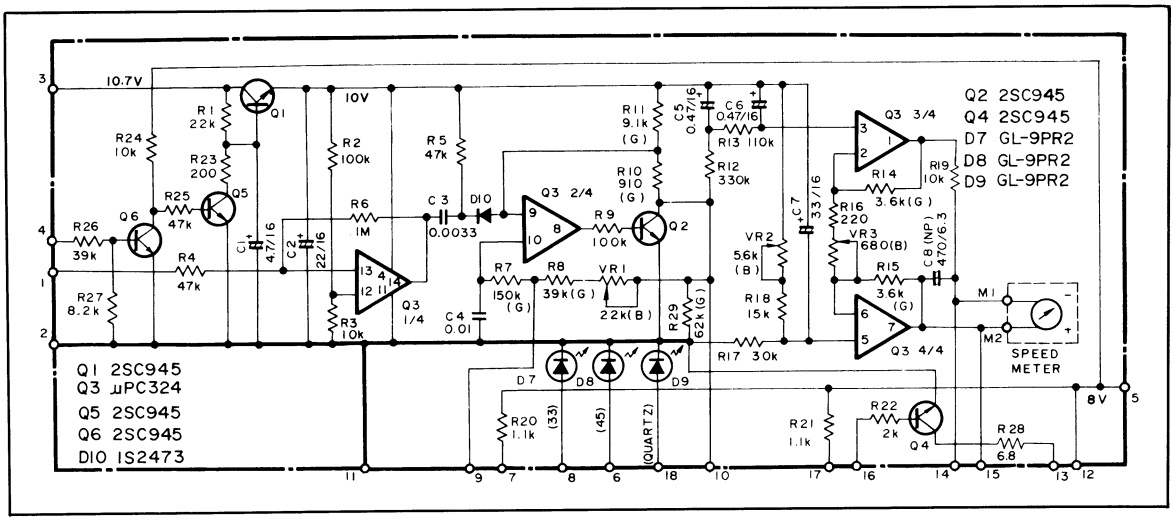
OSCILLATOR ASSEMBLY (PWX-022)



MOTOR



5.4 CONTROL (B) ASSEMBLY (XWX-007)



Parts List of Control (B) Assembly (XWX-007)

SEMICONDUCTORS

Part No.	Symbol & Description
2SC945-P	Q1, Q2
μPC-324C	Q3
2SC945-P or Q	Q4 – Q6
1S2473	D10
GL-9PR2	D7 – D9

CAPACITORS

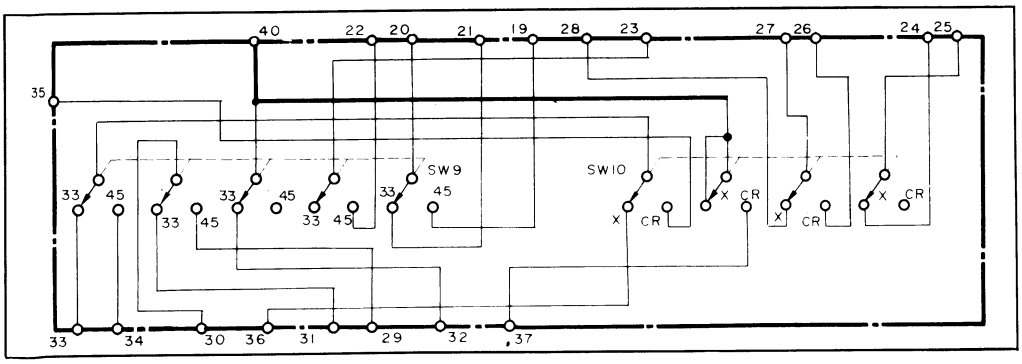
Part No.	Symbol & Description
CEA 4R7P 16	C1
CEA 220P 16	C2
CQMA 332K 50	C3
CQMA 103J 50	C4
CSZA R47M 16	C5, C6
CSZA 330M 16	C7
CEA 471M 6.3NP	C8

Note: When ordering resistors, convert the resistance value into code form, and then rewrite the part no. as before.

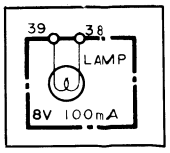
RESISTORS

Part No.	Symbol & Description
RD¼VS □□□ J	R1–R6, R9, R12, R13, R16–R28
RN¼PS □□□ G	R7, R8
RD¼PS □□□ G	R10, R11, R14, R15
RD¼VS □□□ G	R29
PCP-020 or PCP-013	VR1
PCP-023 or PCP-024	VR2
PCP-022 or PCP-007	VR3

5.5 SWITCH ASSEMBLY (XWX-008) and LAMP ASSEMBLY (XWX-009)



LAMP ASSEMBLY (XWX-009)



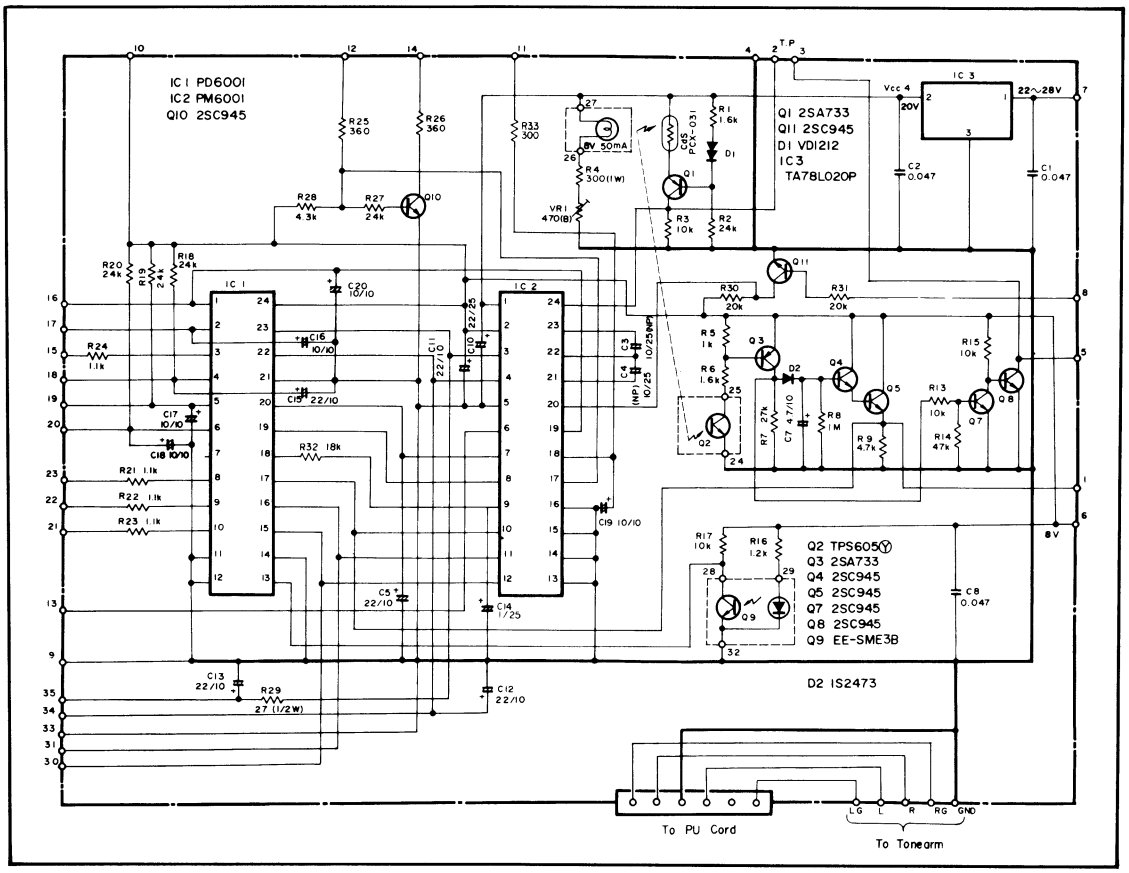
Parts List of Switch Assembly (XWX-008)

Part No.	Symbol & Description
PSG-010	Push switch
PSG-011	Push switch

Part List of Lamp Assembly (XWX-009)

Part No.	Symbol & Description
PEL-033	Lamp

5.6 TONEARM DRIVE ASSEMBLY (PWX-027)



Parts List of Tonearm Drive Assembly (PWX-027)

SEMICONDUCTORS

Part No.	Symbol & Description
PD6001	IC1
PM6001	IC2
TA78L020P	IC3
2SA733P or Q	Q1, Q3
TPS605-Y	Q2
2SC945-P or Q	Q4, Q5, Q7, Q8, Q10, Q11
EE-SME3B	Q9
PCX-031	cds
VD1212	D1
1S2473	D2

CAPACITORS

Part No.	Symbol & Description
CKDYF 473Z 50	C1, C2, C8
CEA 100P 25NP	C3, C4
CEA 220P 10	C5, C12, C13, C11
CSZA 4R7M 10	C7
CEA 220P 25	C10
CSZA 010M 25	C14
CSZA 220M 10	C15
CSZA 100M 10	C16–C20

Note: When ordering resistors, convert the resistance value into code form, and then rewrite the part no. as before.

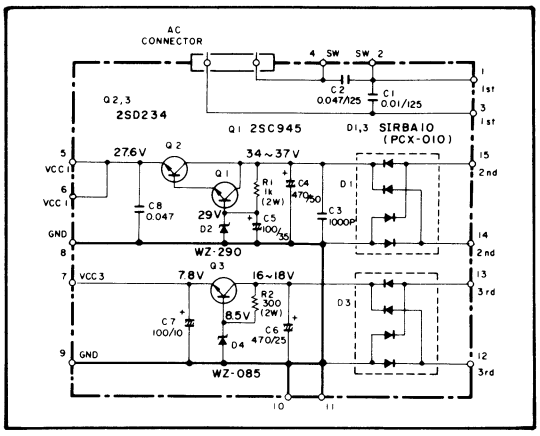
RESISTORS

Part No.	Symbol & Description
RD¼VS □□□ J	R1–R3, R5, R6, R8, R9, R16–R20, R22–R28
RS1P □□□ J	R4
RD¼PS □□□ J	R7, R15, R13, R14, R32, R21,
RD¼VS □□□ J	R30, R31, R33
PCP-025 (PCP-010)	VR1

OTHERS

Part No.	Description
PEB-123	Rubber bush
PKP-020	Connector 5p
PEL-025	Lamp

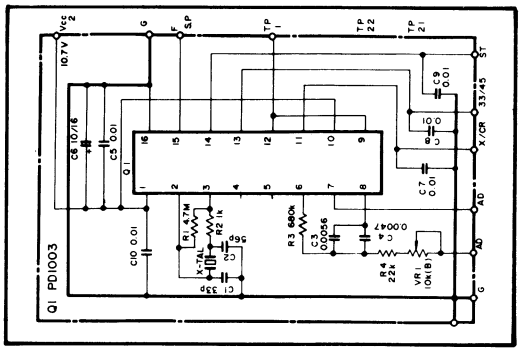
5.7 POWER SUPPLY ASSEMBLY
PWR-048 . . . KUT
PWR-049 . . . KCT



Parts List of Power Supply Assembly

Part No.	Symbol & Description
2SC945-P or Q	Q1
2SD234-O or Y	Q2, Q3
SIRBA10	D1, D3
WZ-290	D2
WZ-085	D4
RS2P 102J	R1
RS2P 301J	R2
PCL-020 (KCT)	C1
PCL-021 (KUT)	C1
PCL-019 (KCT)	C2
KCE-005 (KUT)	C2
CKDYF 102Z 50	C3, C8 (KUT)
CEA 471P 50	C4
CEA 101P 35	C5
CEA 471P 25	C6
CEA 101P 10	C7
CKDYF 473Z 50	C8 (KCT)
PEC-043	Capacitor cover

5.8 OSCILLATOR ASSEMBLY (PWX-022)



Note: When ordering resistors, convert the resistance value into code form, and then rewrite the part no. as before.

Parts List of Oscillator Assembly (PWX-022)

CAPACITORS

Part No.	Symbol & Description
CCDCH 330J 50	C1
CCDCH 560J 50	C2
CQMA 562J 50	C3
CQSH 472J 50	C4
CKDYF 103Z 50	C5, C7–C10
CEA 100P 16	C6

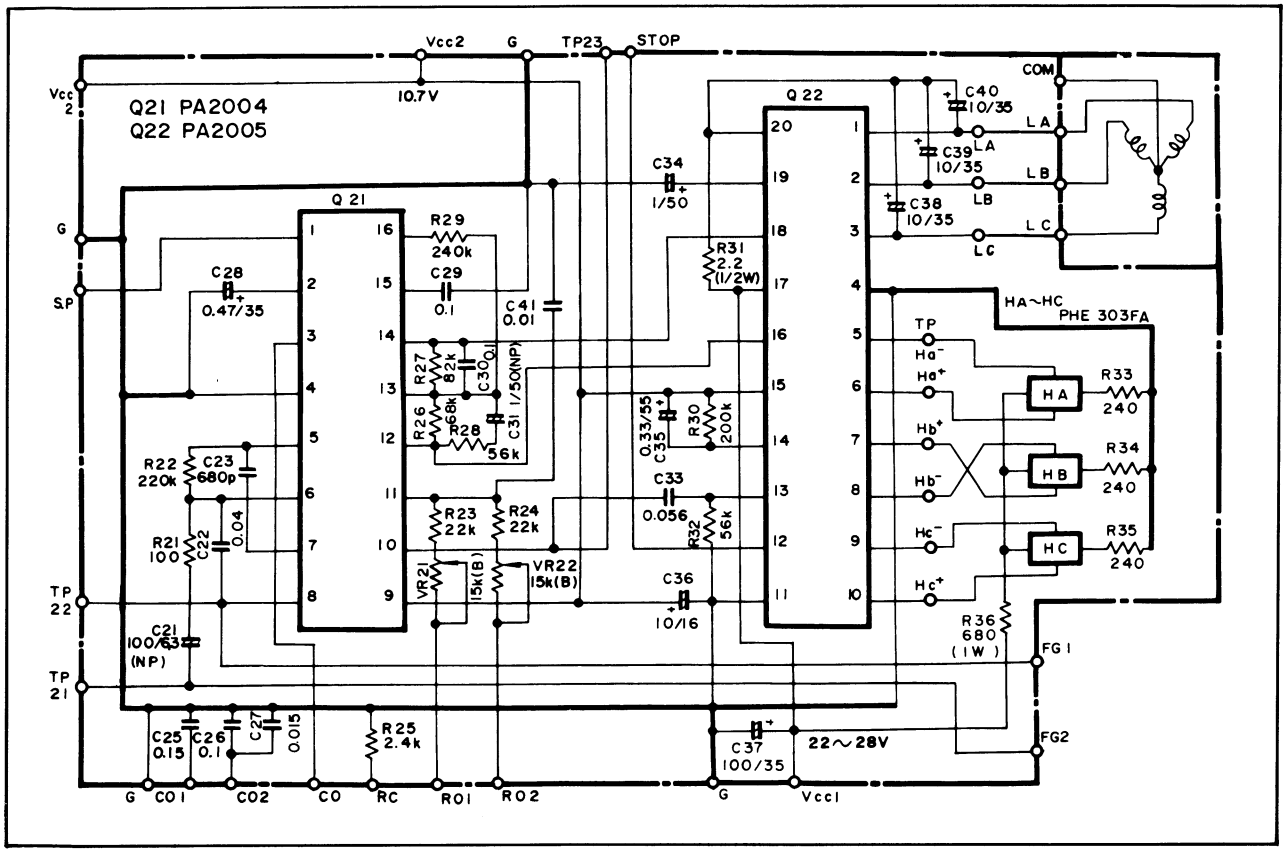
RESISTORS

Part No.	Symbol & Description	
RD¼PS □□□ J	R1–R3	
RN¼PS □□□ G	R4	
PCP-015	VR1	10kΩ-B

SEMICONDUCTORS

Part No.	Description
PD1003	IC
PSS-003	Crystal

5.9 DRIVE CONTROL ASSEMBLY (PWG-017)



Parts List of Drive Control Assembly (PWG-017)

CAPACITORS

Part No.	Symbol & Description
CEA 101M 6.3NP	C21
CKDYF 403Z 50	C22
CKDYB 681K 50	C23
CQMA 154J 50	C25
CQMA 104J 50	C26, C30
CQMA 153J 50	C27
CSZA R47K 35	C28
CQMA 104K 50	C29
CEA 010M 50NP	C31
CQMA 563K 50	C33
CEA 010P 50	C34
CSZA R33K 35	C35
CSZA 100K 16	C36
CEA 101P 35	C37
CEA 100P 35	C38, C39, C40
CKDYF 103Z 50	C41

Note: When ordering resistors, convert the resistance value into code form, and then rewrite the part no. as before.

RESISTORS

Part No.	Symbol & Description	
PCP-019	VR21, VR22	15kΩ-B
RD¼PS □□□J	R21–R30, R32–R35	
RD½PS □□□J	R31	
RS1P □□□J	R36	

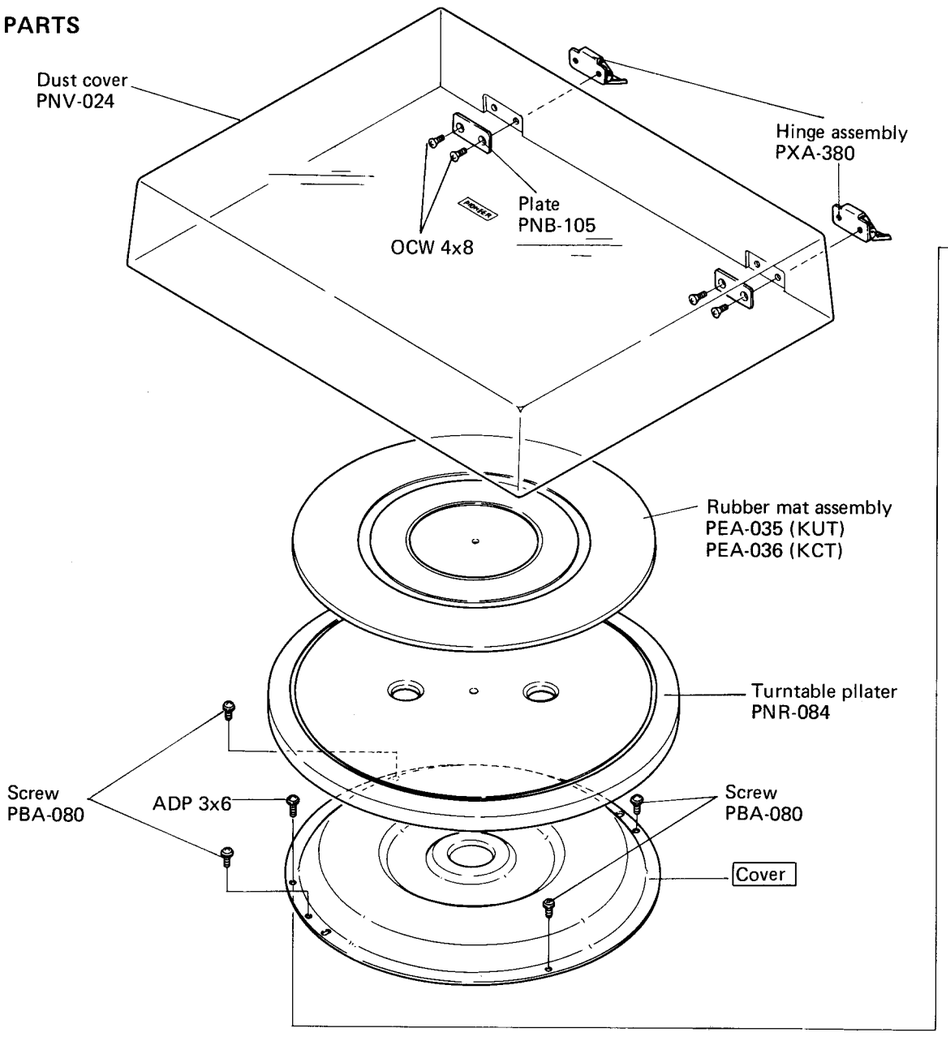
SEMICONDUCTORS

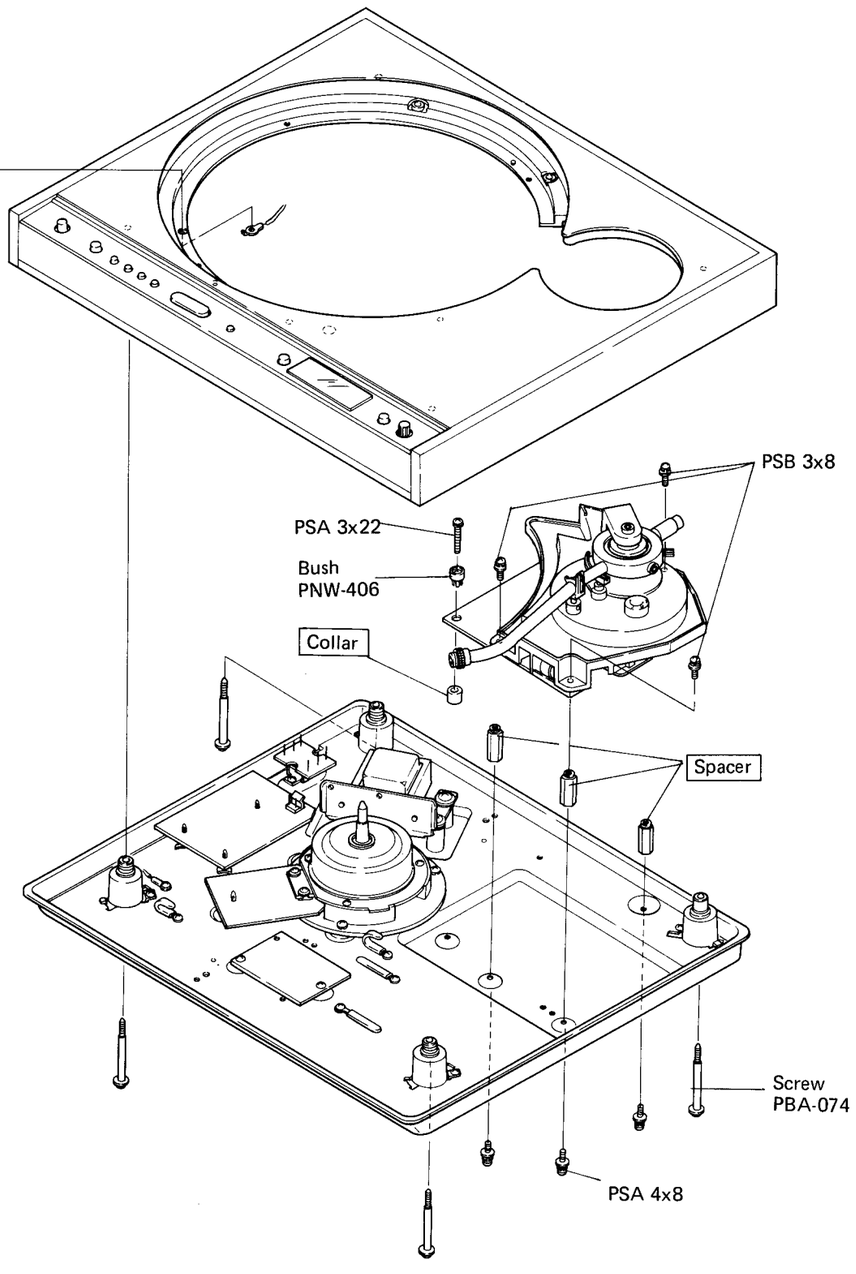
Part No.	Symbol & Description
PA2004	Q21
PA2005	Q22
PCX-039	HA, HB, HC Hall element
PTL-003	Armature core assembly

6. EXPLODED VIEW

NOTE:
marked parts cannot be supplied.

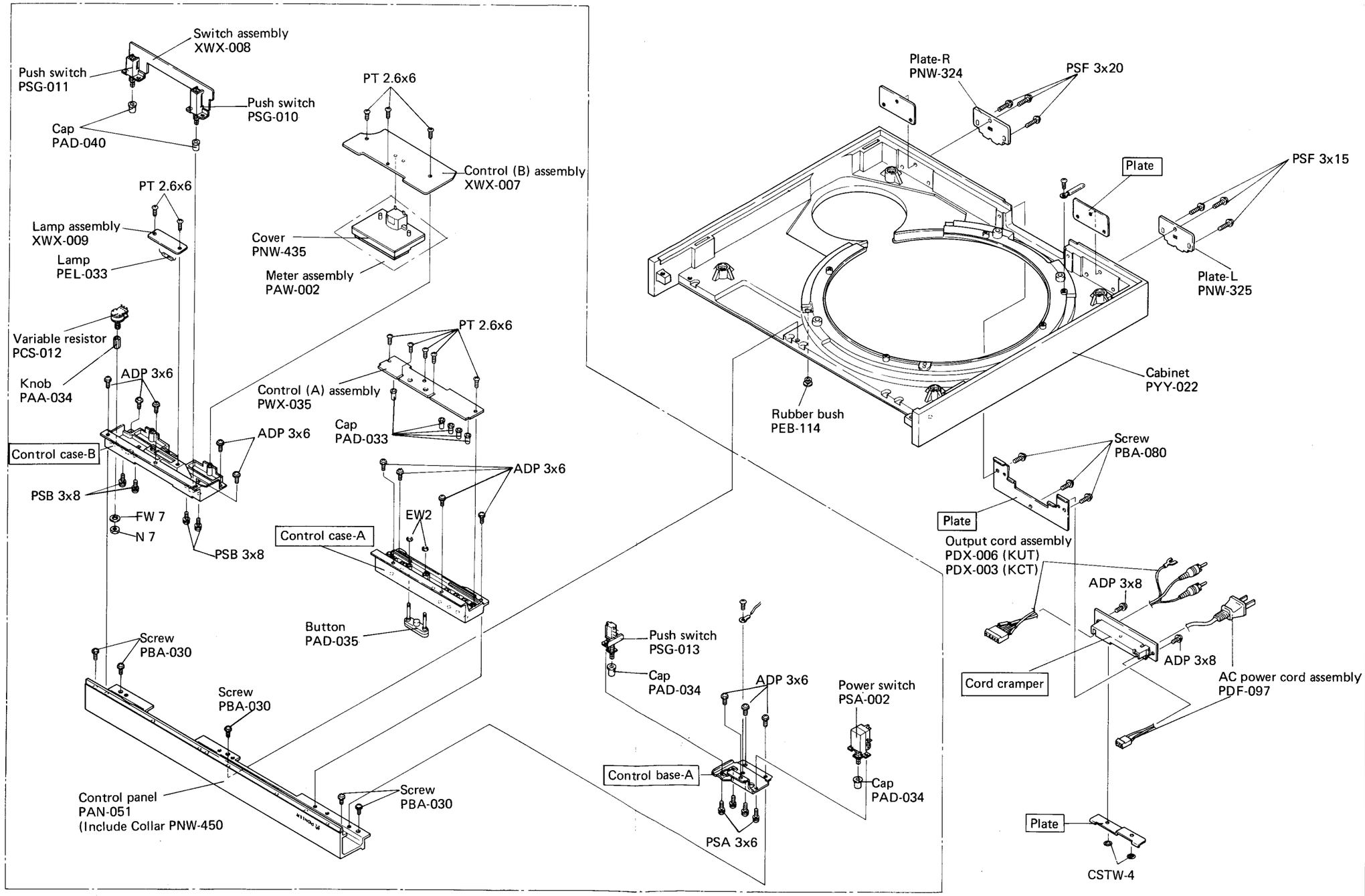
6.1 OUTER PARTS





6.2 CABINET

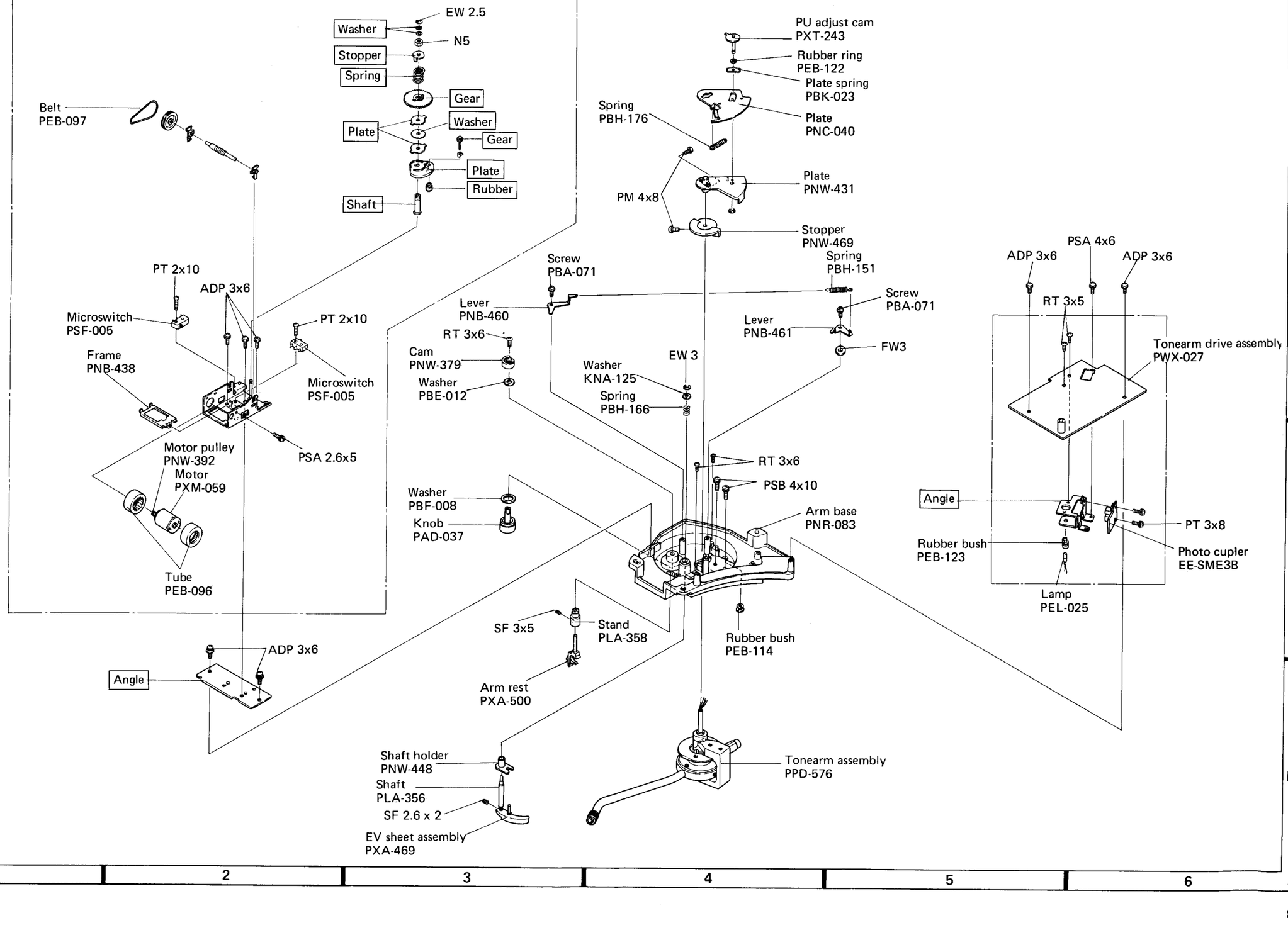
NOTE:
marked parts cannot be supplied.



6.3 TONEARM (ARM BASE)

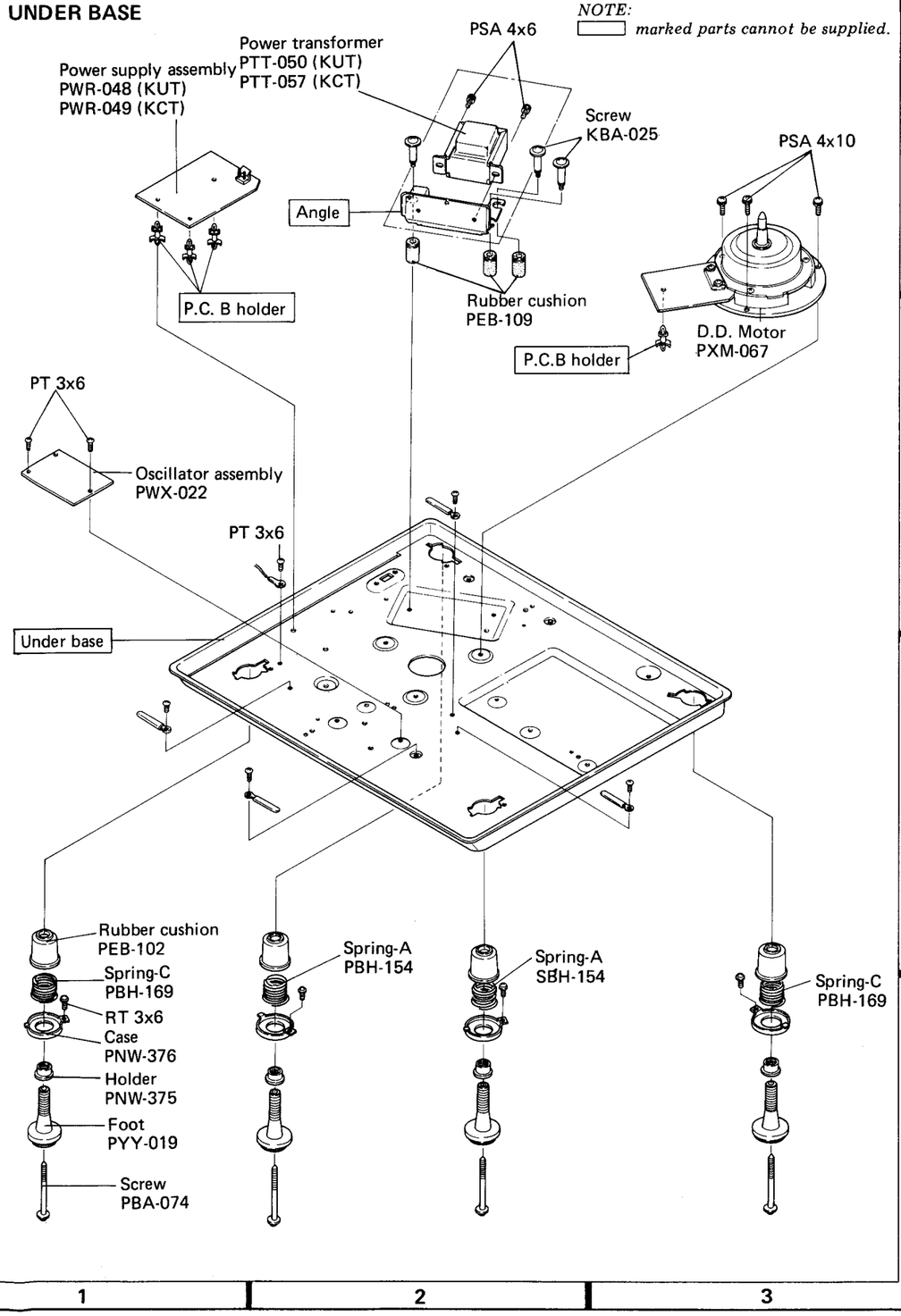
Mechanism assembly PXA-461

NOTE:
marked parts cannot be supplied.



6.4 UNDER BASE

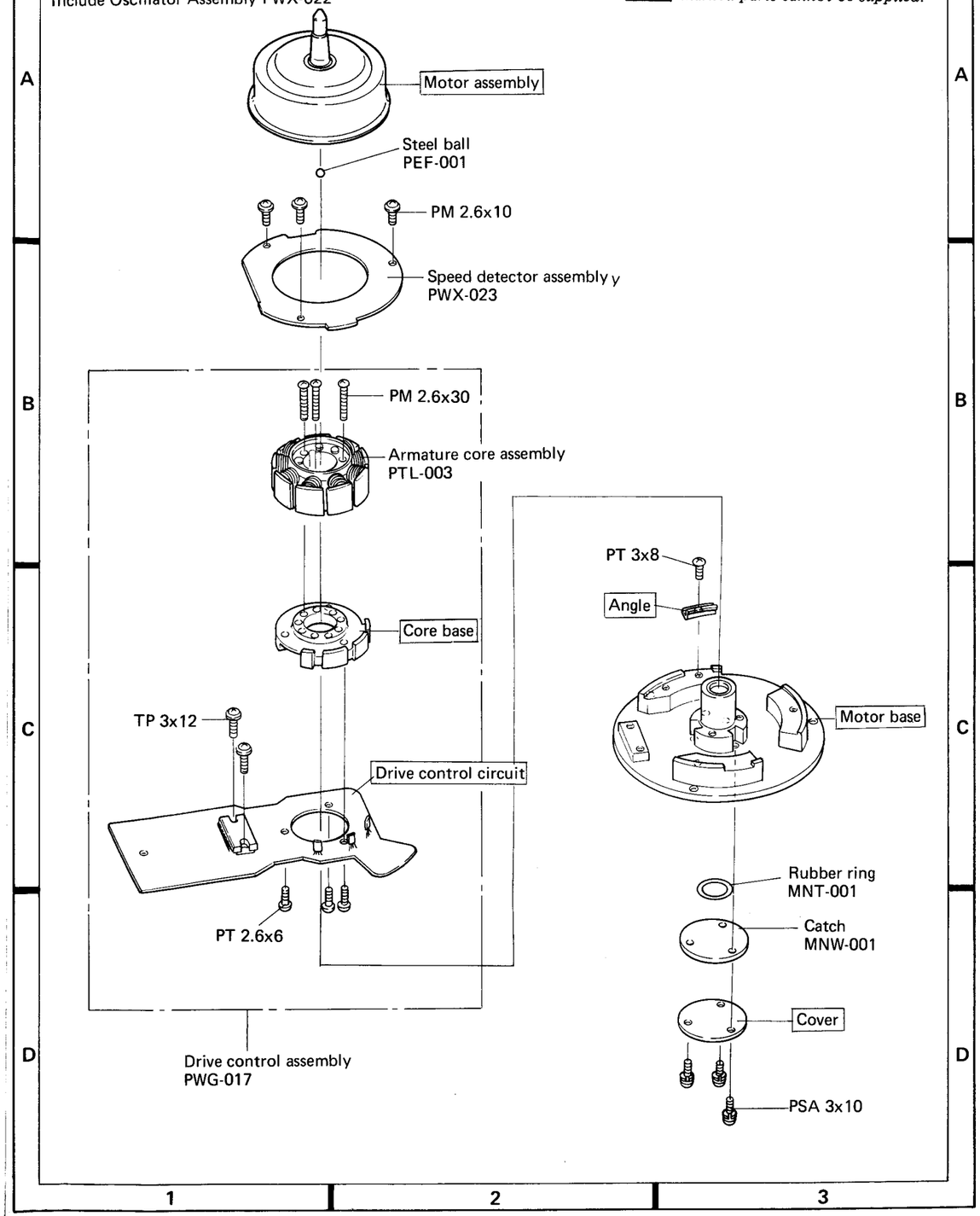
NOTE:
□ *marked parts cannot be supplied.*



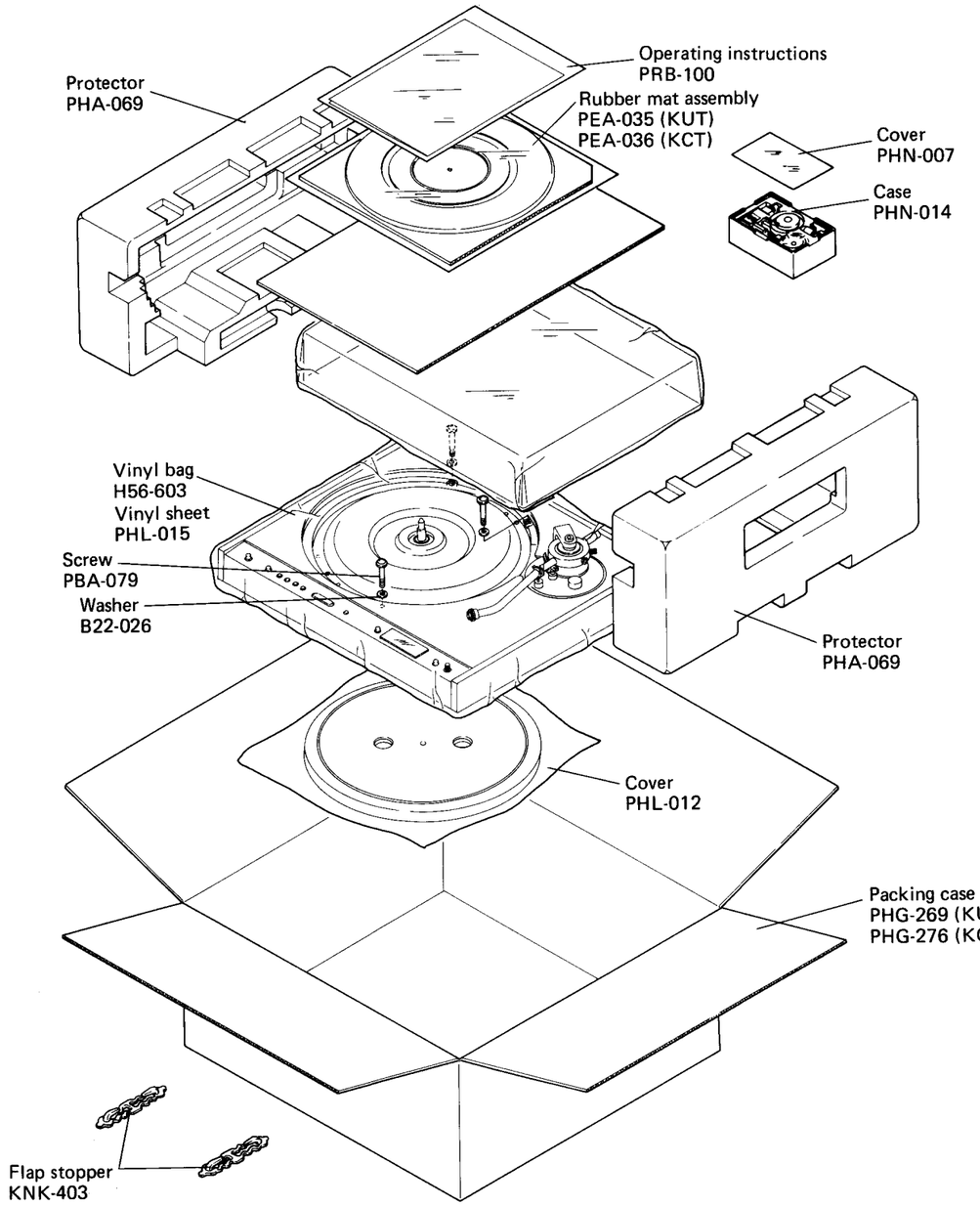
6.5 D.D. MOTOR (PXM-067)

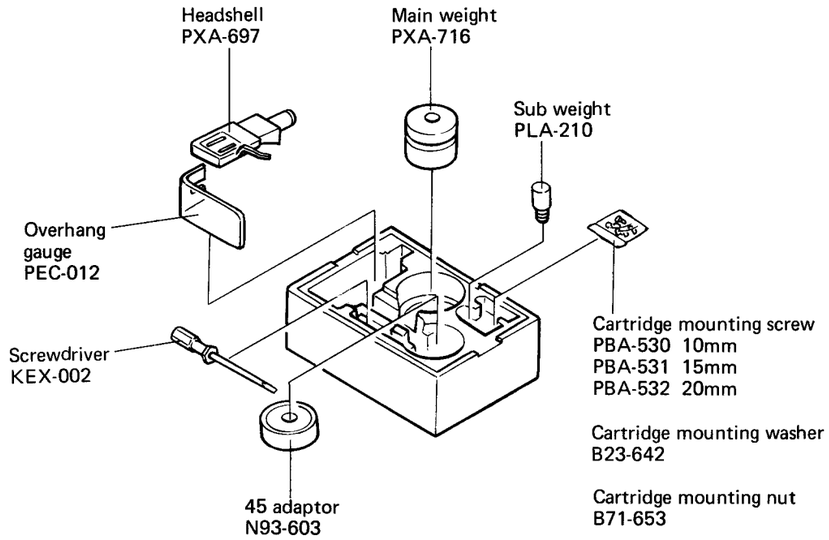
Include Oscillator Assembly PWX-022

NOTE:
□ *marked parts cannot be supplied.*



6.6 PACKING


Protector
PHA-069
Operating instructions
PRB-100
Rubber mat assembly
PEA-035 (KUT)
PEA-036 (KCT)
Cover
PHN-007
Case
PHN-014
Vinyl bag
H56-603
Vinyl sheet
PHL-015
Screw
PBA-079
Washer
B22-026
Protector
PHA-069
Cover
PHL-012
Packing case
PHG-269 (KUT)
PHG-276 (KCT)
Flap stopper
KNK-403


Headshell
PXA-697
Main weight
PXA-716
Sub weight
PLA-210
Overhang
gauge
PEC-012
Screwdriver
KEX-002
45 adaptor
N93-603
Cartridge mounting screw
PBA-530 10mm
PBA-531 15mm
PBA-532 20mm
Cartridge mounting washer
B23-642
Cartridge mounting nut
B71-653

7. DESCRIPTION OF OPERATION

The PL-630 can be broadly divided into the mechanical section centered about the arm drive, and the electronic circuitry which controls the lead-in and drop position. Although both of these parts (i.e. the mechanical and electronic sections) operate in onjunction with each other, they will be described separately below.

First obtain an understanding of the operation of each individual part in order to understand the overall system.

7.1 MECHANICAL SECTION

Construction

- Worm gear
  The worm gear transmits the rotation of the motor via a belt.
- Gear A
  Gear A is driven by the worm gear.
- Plate
  The plate is synchronized with the rotation of gear A and is fixed in position by means of the slip action of a friction plate. It is provided with an UP-DOWN slope for arm elevation.
- Gear B
  Gear B rotates when gear A rotates and the plate is in position. A rotating roller is directly coupled to gear B.
- SW_1 and SW_2 (Microswitches)
  These switches are turned on and off by the action of the plate, resulting in signals being applied to the neutral return part of the IC PM6001 in the control section. When the unit is in the neutral position, both SW_1 and SW_2 will turned on. Also, SW_2 is in parallel with the rest switch output in the control section.

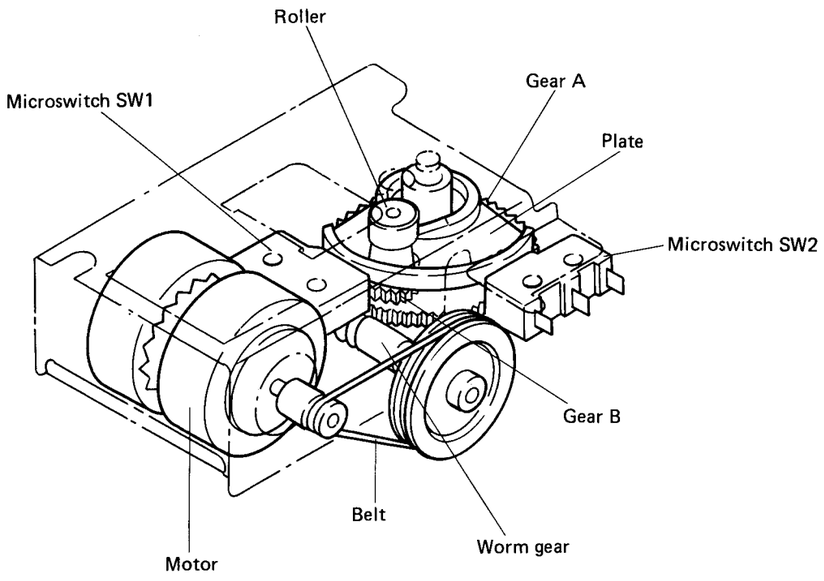


Fig. 4 Construction

Operation

- Neutral position
  If the unit is not in the neutral position when the power is turned on, a signal will be emitted from the control section to cause the unit to go into the neutral position (See Fig. 5).
- Lead-in

1. At a signal from the control section, the gear motor will start to rotate, and gear A (plate) will rotate in the clockwise direction. Owing to the slope on the plate, the arm will be lifted up (Fig. 6).
2. When the roller on the plate comes into contact with PU plate A, the plate alone will stop.
3. As gear A will continue to rotate, gear B (roller) will also rotate. The arm will then be led in as a result of the friction between the roller and the PU plate A (Fig. 7).
4. Upon completion of lead-in, a signal will be emitted whereupon gear A will rotate in the anticlockwise direction and return to the neutral position. Owing to the slope on the plate, the arm will be lowered.

- Auto-return
  When a signal is received from the control section, gear A (plate) will rotate in the anti-clockwise direction (Fig. 8). Operation thereafter is basically the same as that described in the above paragraph (Lead-in).

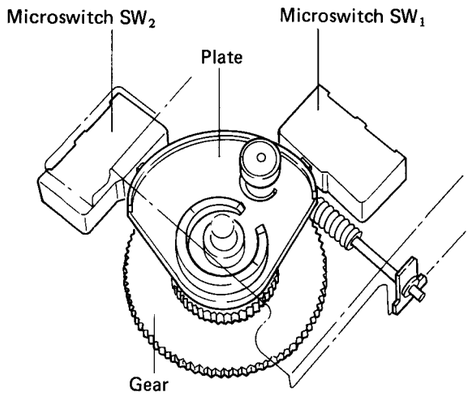


Fig. 5 Neatral position

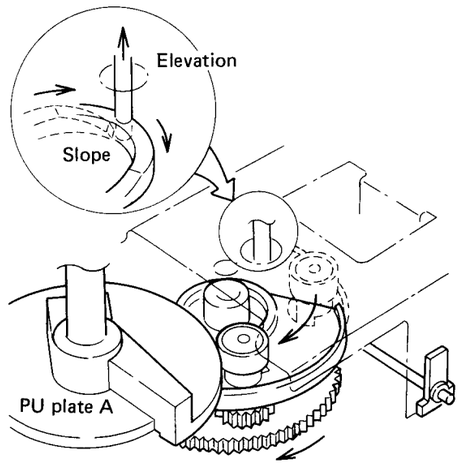


Fig. 6 Elevation up

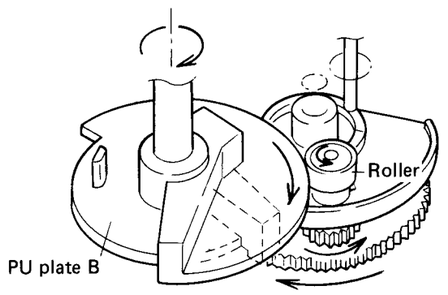


Fig. 7 Tonearm lead in

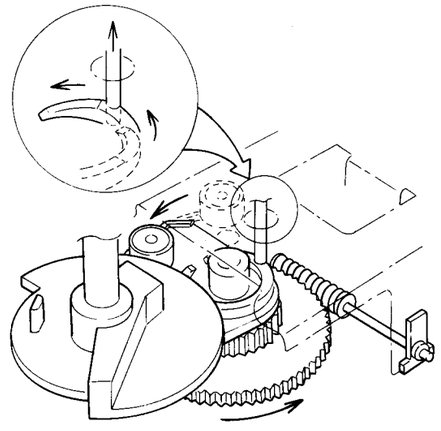


Fig. 8 Elevation down

7.2 CONTROL SECTION (ELECTRICAL SECTION)

Construction

The control section consists of 2 ICs which process signals inputted from the various detection and operation units to control the mechanical section. Details of the detection units are given diagrammatically for each item.

Detection Units

- Lowering position sensor (photo-coupler)

1. This sensor consists of an LED and a PTr (photo-transistor) located on either side of PU plate B.
2. When the arm moves, PU plate B will also move, and as a result light from the LED will pass through the slit in PU plate B to turn on the PTr.

- End detector sensor

1. When the stylus tip moves to within 62mm from the center shaft of the player, light from the lamp which was blocked by PU palte B will strike the CdS cell.
2. The output voltage from the CdS cell will become proportionately larger as the stylus tip moves towards the inner groove. This voltage change will be applied to the end detector part of the IC to permit detection of the lead-out groove.

- Rest switch

1. When the arm is in the rest position, the light from the lamp will be prevented from striking the PTr by means of the light shield on PU plate B.
2. When the arm moves towards the center shaft, light will strike the PTr. The PTr output will become the phono-motor START signal in the case of manual operation, or will become the signal used to detect the return of the arm to the rest position during automatic operation.

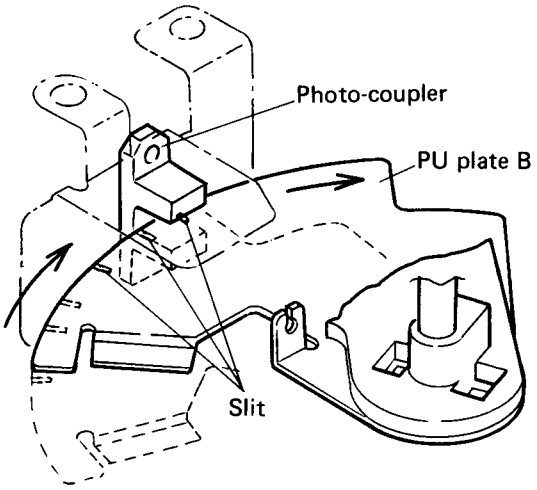


Fig. 9 Lowering position sensor

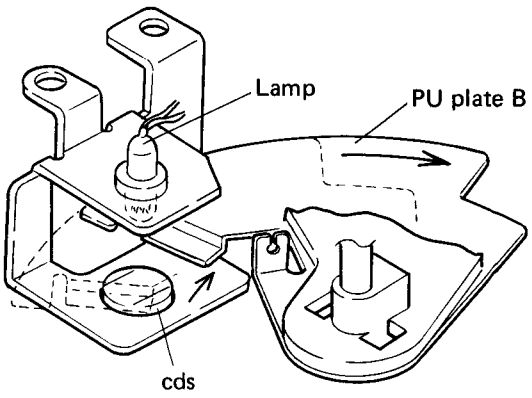


Fig. 10 End detector sensor

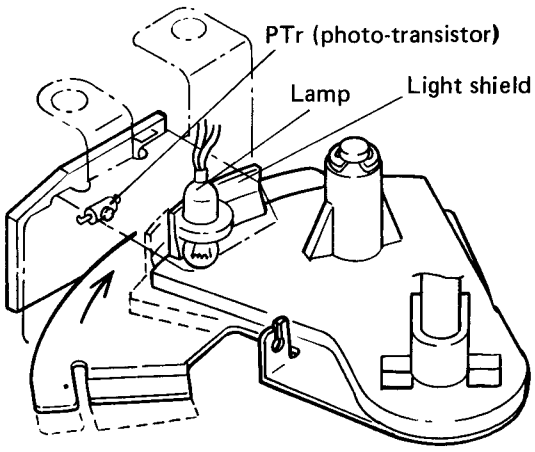


Fig. 11 Rest switch

IC PM6001

- Motor drive part

1. This part of the IC receives signals from FF_1, FF_2 and the neutral return part, etc., to control the direction of rotation of the gear motor.
2. When a signal is received from FF_1, gear A will move in the clockwise direction.
   When a signal is received from FF_2, gear A will move in the anticlockwise direction.

- FF_1, FF_2

1. FF_1 applies the lead-in signal to the motor drive section. It is set by the START button and reset by a signal from the parity check part (PD6001).
2. FF_2 applies the return signal to the motor drive section. It is set either by the STOP button or a signal from the end detector. During return, it is reset by a signal from the purity check part.

- Neutral return part

1. The neutral return part receives the various outputs from FF_1, FF_2, SW_1 and SW_2, and sends a signal to the motor drive to restore it to the neutral position.
2. When SW_1 is off and SW_2 is on, the neutral return part sends a signal to the motor drive to cause gear A to rotate in the clockwise direction. When SW_2 alone is off, gear A will rotate in the anticlockwise direction.
3. The neutral return part receives a signal from ARM ELEVATION switch (UP, DOWN) to control the output signal to the motor drive.

- Signal selection part

1. Because both START and STOP operations are performed by the same button, the signal selection part looks at the signal which comes in from the rest switch, turns it into either a START or STOP signal as appropriate, and then applies this signal to either FF_1 or FF_2.
2. When the arm is sitting on the rest, a START signal will be emitted from the signal selection part.

- End detection part

1. The end detector part compares the difference between the output of the CdS cell and the reference voltage, for each revolution of the record, and sends out an auto-return command.
2. When the phono-motor is rotating at either 33 or 45rpm, 100 pulses per revolution of the disc will be received from the frequency generator inside the phono-motor.
3. The end detector part will be reset by the first pulse, and will start to compare the output from the CdS cell with the reference voltage, for each revolution of the record, commencing from the 100th pulse. When the change in the output of the CdS cell exceeds the reference voltage, the end detector part will send out an auto-return command.

- EV control part

1. When the arm is about to be raised, the EV control part will prevent the operation of the neutral return part and also send an UP signal to the motor drive part.
2. The motor drive part will cause gear A to rotate in the clockwise direction, in the same manner as during lead-in. The plate will stop the instant that SW_1 is put on.
3. Owing to the slope of the plate, the arm will be raised up.
4. When the arm is about to be lowered, the operation blockage will be removed from the neutral return part. As a result, gear A will rotate in the anticlockwise direction to lower the arm.

IC PD6001

- Counter part

1. This part counts the number of signals (number of times that PU plate B slips) received from the lowering position sensor, and sends an output to the part.
2. The counter part is always reset during both start and auto-return.
3. During lead-in, the '30cm' slit is counted as the first slit and the '17cm slit' as the third slit. Conversely, during auto-return, the '17cm slit' is counted as the first slit and the '30cm' as the third slit.
4. During return, the counter only operates when the repeat switch is on.

- Manual size selector

1. The manual size slector records the size of the record on the turntable by means of a signal received from the record size selector button, and sends an output signal corresponding to the particular size to the lowering position selector/turnover part.
2. Once a particular record size has been selected, this information will be retained until the next time the selection button is pressed.

- Lowering position selector/inversion part

* Lowering position selector part

1. The lowering position selector part receives the record size signal sent from the manual size selector, and determines the arm lowering position for each size.

2. The lowering position in the case of a 30cm record will be No.1, and for a 17cm record will be No.3. The output from the lowering position selector part will be applied to the parity check part.

* Inversion part

3. The inversion part operates only during auto-reverse. It makes the lowering position selection the reverse of that for lead-in.
4. In other words, the lowering position in the case of a 30cm record will be No.3, and for a 17cm record will be No.1.

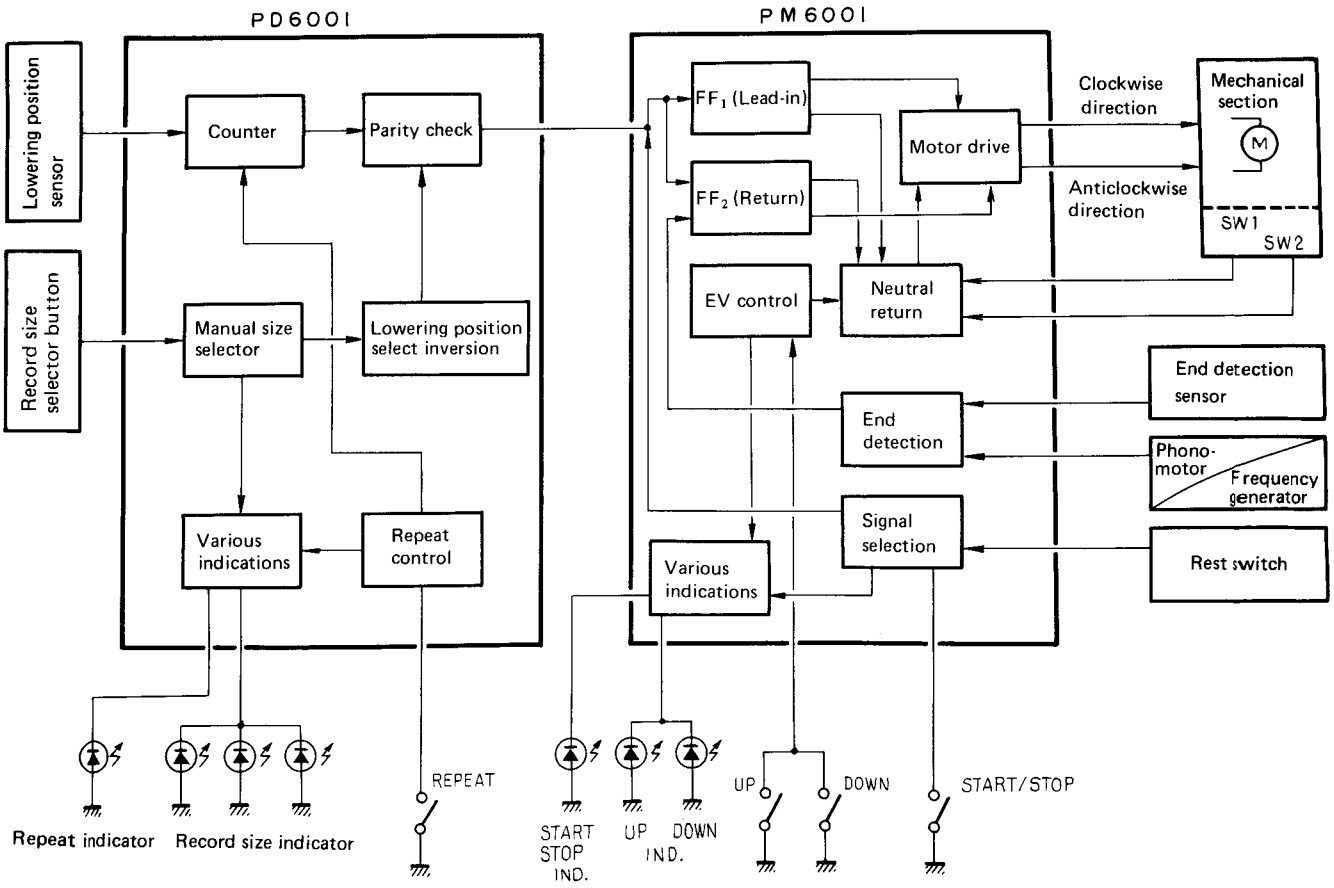
- Parity check part

1. The parity check part compares the signal (output from inversion part) form the lowering position selection part with the output of the counter. If both values coincide, a reset signal will be sent to FF_1 and FF_2.

- Repeat control part

1. When the REPEAT button is pressed, the repeat control part instructs the counter to operate during return.

IC Block Diagram



This block diagram has been abbreviated in order to facilitate understanding of the basic operation.

7.3 ACTUAL OPERATION (17cm record)

Auto-lead-in

1. When the START button is pressed, the neutral return part will be prevented from operating, and FF_1 will be set. FF_1 will send an arm lead-in signal to the motor drive part, and the gear motor will start to rotate.
2. The gear motor will rotate gear A in the clockwise direction, and turn off SW_2. This will cause the phono-motor to start up. Simultaneously, the slope on the plate will cause the arm to be raised up.
3. As a result of the signal sent from the record size selector button, the lowering position selector part (The inversion part will not operate.) will send the tone-arm lowering position signal to the parity check part. In the case of a 17cm record, a signal will be emitted which will cause the arm to be lowered at position No.3.
4. Gear A will continue to rotate until PU plate A comes into contact with the roller, whereupon arm lead-in will commence.
5. The output of the counter part will be sent to the parity check part. If the third position is counted and agrees with the signal from the lowering selection part, the parity check part will send out a reset signal to FF_1.
6. When FF_1 is reset, the arm lead-in operation will stop. Simultaneously, the operation blockage will be removed from the neutral return part, and gear A will turn in the anticlockwise direction to restore the arm to the neutral position.
7. Owing to the slope on the plate, the arm will be lowered onto the record.

Auto-return

1. The end sensor will send the large voltage change appearing when the stulus reaches the lead-out groove of the record, to the end detection part.
2. The end detection part will judge when the end of the recorded groove has been reached, and will then send a reset signal to FF_1 and an operation inhibit direction to neutral return part.
3. FF_2 will send a return directive to the motor drive part, as a result of which gear A will start to rotate in the anticlockwise direction. As a result of the slope of the plate, the arm will be raised up. After the roller comes into contact with PU plate A, the arm will be returned to the arm rest.
4. When the arm returns to the arm rest, the output from the rest switch will cause FF_2 to be reset. Simultaneously, the operation inhibit condition will be removed from the neutral return part.
5. Gear A will return to the neutral position and the arm will be lowered, thus completing operation.

Auto-stop

1. If the START/STOP is pressed during play, the signal selection part will send out a STOP signal.
2. The above STOP signal will cause FF_2 to be set, thus commencing return operation.

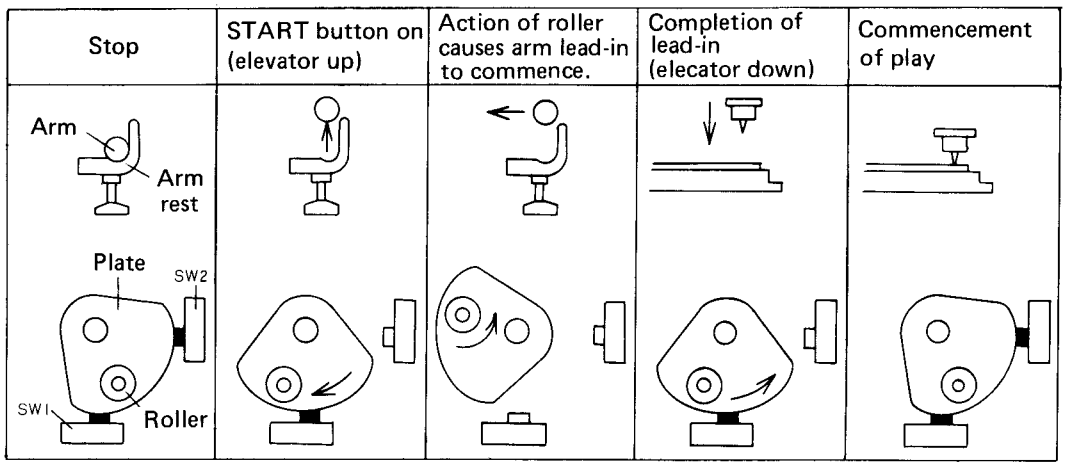
- For details of subsequent operation see previous section entitled "Auto-return".

Auto Repeat

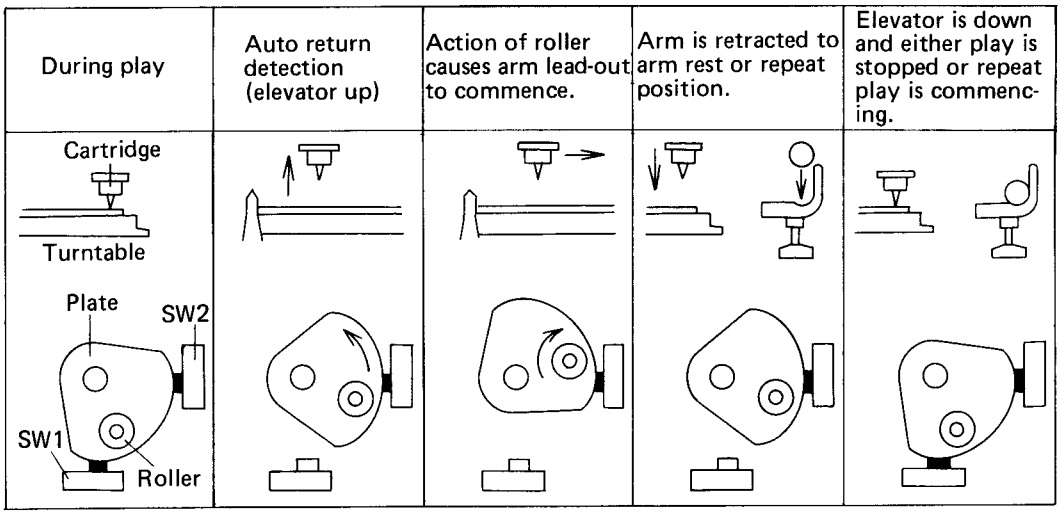
1. As the REPEAT switch is on, the counter part will operate during return operation as well.
2. Owing to the operation of the inversion part, the first (third during lead-in) lowering position selection signal will appear.
3. Because of return operation, the '17cm' slit of PU plate B will be the first slit to pass the lowering sensor. The resulting signal will be sent from the counter part to the parity check part.
4. When the lowering position selection signal agrees will the above signal, a reset signal will be sent from the parity check part to FF_2, and the arm will then be lowered onto the record.

7.4 ACTUAL OPERATION OF MECHANICAL SECTION

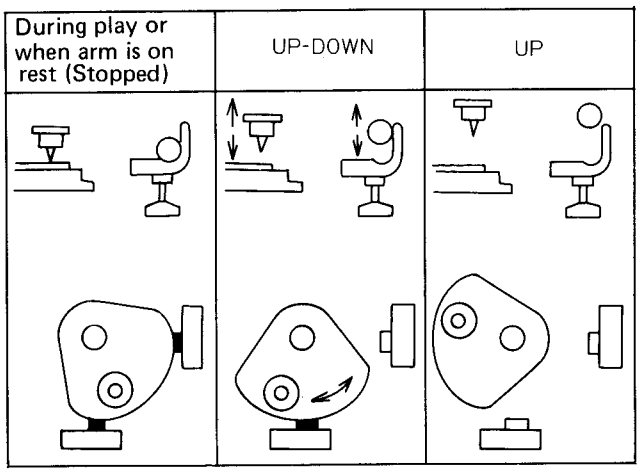
- Automatic lead-in

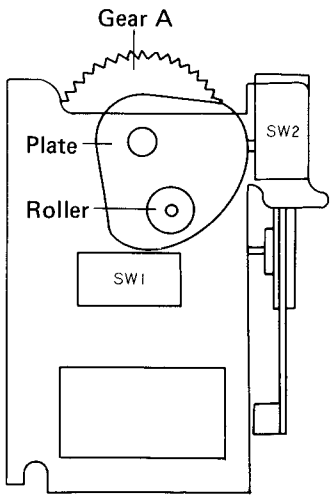


- Auto-return (Auto-repeat)



- Arm elevator





8. ADJUSTMENT

8.1 STYLUS LOWERING POSITION

1. Remove the rubber bush behind the tone-arm.
2. Check to see if the lowering position error is inside or outside the true position.
3. Place the tone-arm on the arm rest and turn the adjusting screw using a Phillips head screwdriver.
4. If the positioning error is inside the true position, turn the adjusting screw anticlockwise, and vice versa.

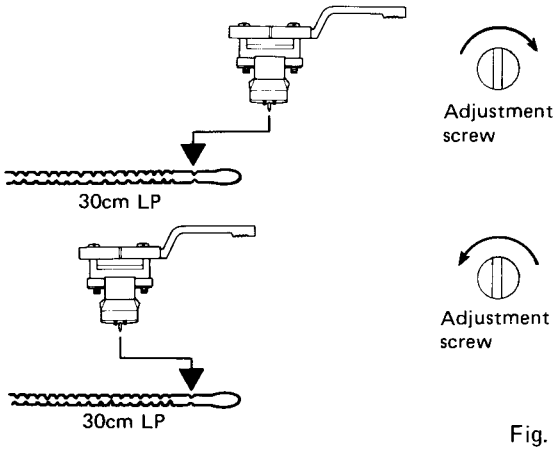


Fig. 12

8.2 ADJUSTMENT OF D.D. MOTOR OPERATING POINT

- Adjustment conditions
  Connect the SP and TP_{23} terminals of PWG-017 to each input of a double image oscilloscope (synchroscope). Put the turntable in the Quartz Lock ON condition, and then start it up.
- Method of adjustment

1. Observe the output waveforms from SP and TP_{23} (Fig. 13). (Two output pulses from terminal TP_{23} will correspond with one pulse from terminal SP.
2. Adjust the semi-fixed resistor in the drive control assembly (PWG-017) so that the rising part of the pulse which comes out of terminal TP_{23} fits into the middle of the pulse which is generated at terminal SP. For 33-1/3 rpm, adjust VR_{21}. For 45 rpm adjust VR_{22}.

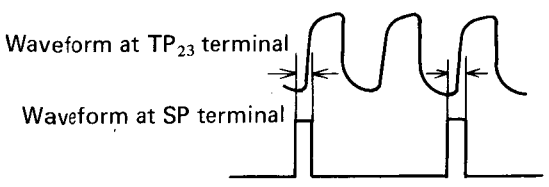


Fig. 13

8.3 SPEED ADJUSTMENT WHEN QUARTZ LOCK IS OFF

1. Put the quartz lock off.
2. Turn the ADJUST knob on the control panel to the mechanical center position.
3. Insert a screwdriver through the small hole in the baseplate of the player, and turn the semi-fixed speed adjustment potentiometer VR_1 until the strobe pattern on the turntable becomes stationary.

8.4 SENSITIVITY ADJUSTMENT OF CdS CELL

- Adjustment conditions

1. Remove the turntable and the top cover.
2. Ensure that the separation between the CdS cell and PU plate B is 2.5 to 3.5mm, and that between the CdS cell and the lamp is 10mm.
3. Connect the positive terminal of a voltmeter to terminal 3 of the Tonearm Drive assembly (PWX-027), and the negative terminal to terminal to terminal 5 of the same board.
4. Ensure that terminal 4 of the secondary board is grounded (by connecting it to terminal 5).
5. Take care to ensure that no other light, apart from that of the lamp, strikes the CdS cell.

- Method of adjustment

1. Press the POWER switch on, raise the arm elevator and move the tonearm to the innermost groove on the record.
2. Adjust VR_1 on the Tonearm Drive assembly (PWX-027) so that the voltmeter indication lies between 12.5 and 13.1V.

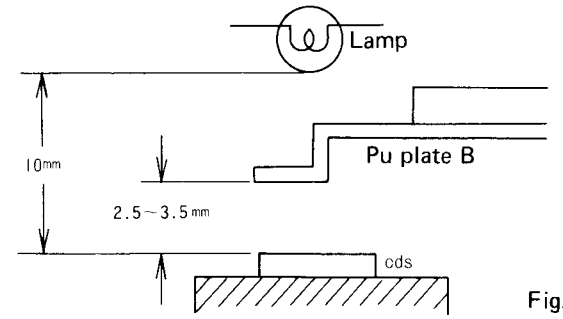


Fig. 14

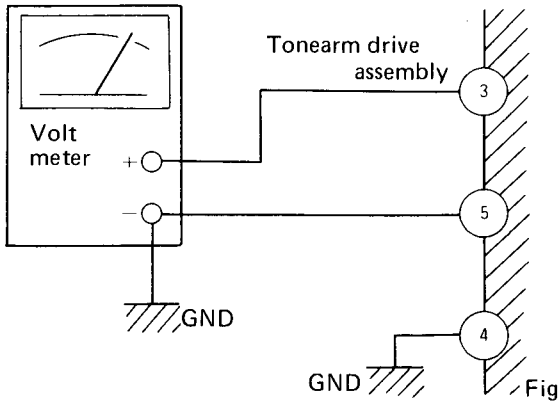


Fig. 15

8.5 METER ADJUSTMENT

- Adjustment conditions

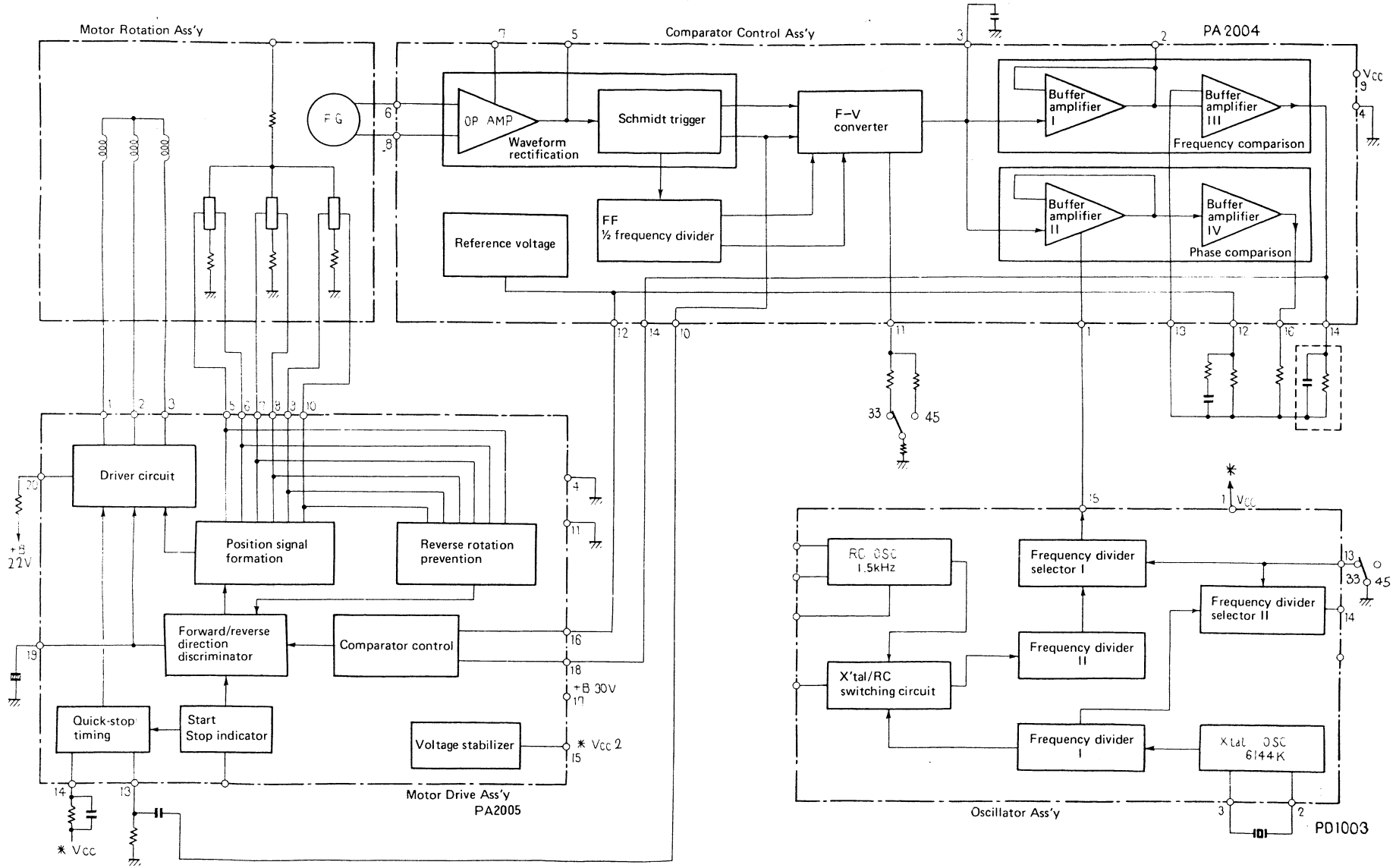
1. Connect a frequency counter between the TP_1 and Gnd terminals of the oscillator assembly (PWX-022).
2. Turn the speed adjust knob to its mechanical center.
3. Put the Quartz Lock off.

- Adjustment

1. Put the speed selector button in the "45" position.
2. Turn VR_1 in the oscillator assembly (PWX-022) until the reading on the frequency counter becomes 750.0Hz.
3. Turn VR_2 in the control (B) assembly (XWX-007) until the meter reading becomes zero.
4. Put the speed selector button in the "33" position, and turn VR_1 until the meter reading becomes zero.
5. Turn the speed adjust knob until the reading on the frequency counter becomes 795Hz (750Hz +6%).
6. Adjust VR_3 so that the meter indication becomes +6%.

. D.D. MOTOR CIRCUIT DESCRIPTIONS AND TROUBLE SHOOTING

.1 BLOCK DIAGRAM



9.2 MOTOR OPERATION

1 Motor Construction

1. The PXM-067 is an outer-rotor brushless DC motor with 6 poles and 9 slots.
2. Motor windings are arranged in a 3-phase Y configuration. For detection of the platter position, 3 Hall elements are mounted at 40° intervals.
3. As the motor rotates, these Hall elements generate an AC voltage dependent upon the strength and direction of the magnetic flux.
4. The bottom side of the rotor magnet possesses 200 magnetic poles. As these rotate above the speed detection plate, an AC voltage is generated which serves as the speed detection signal.
5. The inner surface of the rotor magnet possesses 6 magnetic poles. As shown in Fig.17, these are tilted by 22.0° relative to the vertical axis.

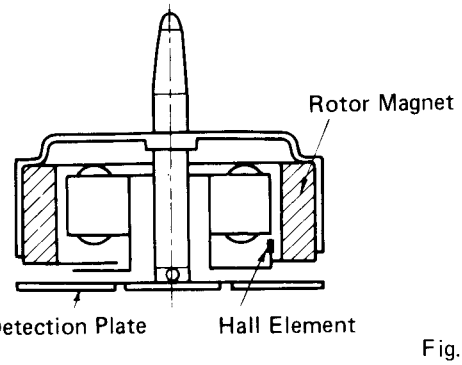


Fig. 16

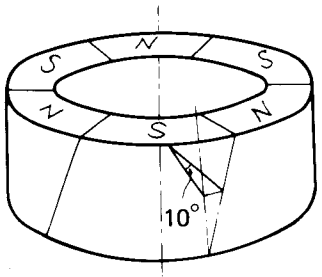


Fig. 17

2. Principle of Motor Rotation

1. Let us assume that the motor is at standstill, in the position shown in Fig. 3.
2. In this position, Hall element H_A is located next to a borderline between south and north poles, H_B next to a south pole, and H_C next to a north pole.
3. When the unit is switched on, the output voltages of the respective Hall elements will be as shown in Fig. 25-a, page 47.
4. The Hall element output is applied to the Position Signal Combination Circuit contained in IC PA-2005 and utilized to control the current flowing to the motor drive coils.
   For further details, see paragraph "Drive Circuit."
5. The output from the Hall elements undergoes waveform formation in the Position Signal Combination circuit. The resulting waveforms are shown in Fig. 25-b, page 47.
6. These composite signals are used to switch the drive current in such a way that each motor winding receives the proper current to polarize the magnetic poles for north, south, or OFF in the correct sequence.

In actual rotation, this happens as follows.

7. As the pole of coil L_A becomes a south pole, that of L_B becomes north, and L_C, neutral.
8. Repulsion between the S pole at L_A and the rotor S pole, and attraction between the L_B N pole and the rotor S pole exert a propulsive force on the rotor.
9. As the rotor turns through 20° of arc, the output from the Hall elements changes.
10. L_B now enters OFF state, L_C becomes a N pole, and L_A a S pole.
11. The L_C N pole now attracts the rotor S pole, and the L_A S pole attracts the rotor N pole. Rotation continues.
12. Correspondences between rotor positions and coil polarities are shown in Fig. 19, a-f.

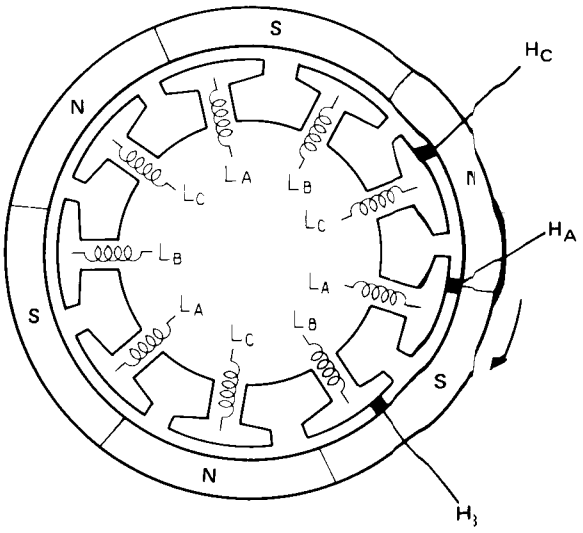


Fig. 18

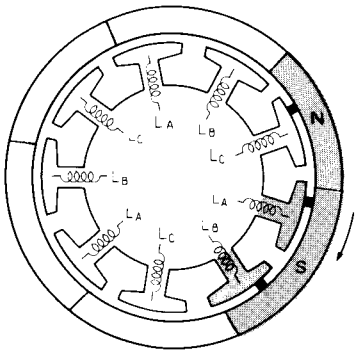


Fig. 19-a

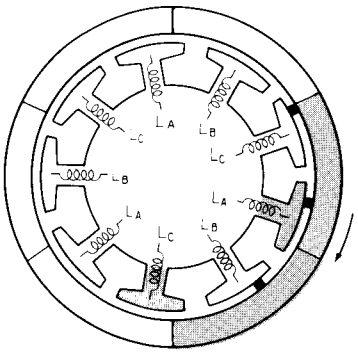


Fig. 19-b

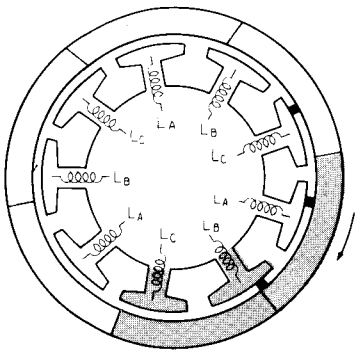


Fig. 19-c

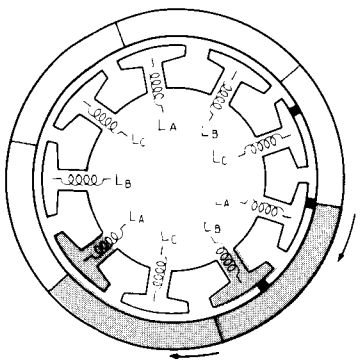


Fig. 19-d

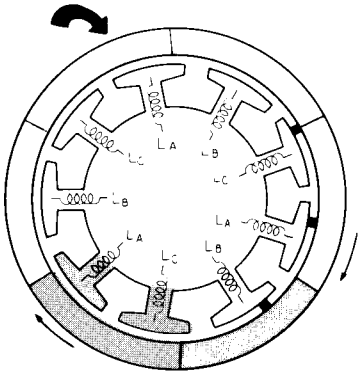


Fig. 19-e

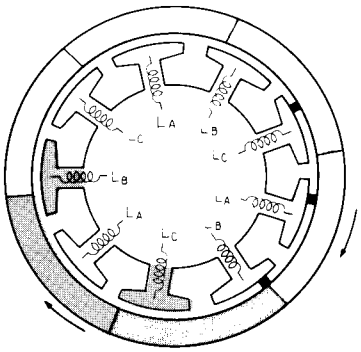


Fig. 19-f

3. Speed Detection Section

1. The speed detection plate has one rows of "detection patterns."
2. The bottom surface of the rotor is magnetized with 200 magnetic poles, and these rotate at a short distance above the speed detection plate.
3. The output voltage from the detection patterns has a frequency of 55.5Hz at 33-1/3 rpm, and of 75Hz at 45 rpm.
4. The signal is supplied to IC PA2004.

9.3 OPERATION OF THE PD1003 IC (OSCILLATOR STAGE)

1. Once the power supply is turned on, the quartz crystal oscillator generates a 6144kHz signal.
2. The frequency of this signal is reduced to 1.5kHz (1/4096 division) by frequency divider I. Part of the resultant signal is passed via the x'tal/RC switching circuit and applied to frequency divider II. The other part of the signal is applied to frequency divider selector II.
3. The 1.5kHz signal applied to frequency divider II is further divided into a 750Hz signal, and applied to frequency divider selector I where the signals are converted into sampling pulses for phase comparison purposes in PA2004.
   33rpm 27.78Hz
   45rpm 37.5Hz
   (In both cases, the pulse width is 0.667ms).
4. Frequency divider selector II converts signals from frequency divider I into pulse signals for the stroboscope lamp drive circuit.
   33rpm 55.5Hz
   45rpm 75.0Hz
   (In both cases, the pulse width is again 0.667ms).
5. The oscillation frequency (1.5kHz) of the RC o.s.c. block can be varied by ±6% with the SPEED ADJ control.
6. Since the reference signal is varied with the SPEED ADJ at Quartz Lock OFF, the speed of the turntable is also variable ±6%.

9.4 OPERATION OF THE PA2004 IC (COMPARATOR CONTROL)

1. Signals from the frequency generator in the motor rotation ass'y are changed into 50% duty square wave signals by the waveform rectifier. The frequencies at this stage are thus,
   33rpm 55.55Hz
   45rpm 75Hz
2. Part of the output is divided by ½ in the FF circuit, and subsequently applied to the FV converter circuit along with the other part of the output formed in step 1 above, thereby forming the FV converter gate pulse signals.
3. The output from the FV converter is applied to buffer amplifiers I and II.
4. The buffer amplifier I output is compared with the reference voltage in buffer amplifier III, and then applied to the output compose circuit.
5. Phase comparison of the sampling pulses from the PD1003 IC with the FV converter output occurs in buffer amplifier II, with the resultant output being applied to buffer amplifier IV.
6. The output from buffer amplifier IV is also applied to the output compose circuit.
7. This output compose circuit consists of a low-pass filter (cut-off frequency 23Hz, cut-off slope —6dB/oct.) which serves to eliminate the carrier component in the output of buffer amplifier II (phase comparison).
8. This final output signal is then passed onto the comparator control stage of the PA2005 IC for comparison with the reference voltage.

9.5 OPERATION OF THE PA2005 IC (DRIVE CONTROL)

- Start/stop indicator stage

1. The input signal to this stage is applied by means of an external start/stop switch. In the PL-630, this switch is a photo-transistor switch activated by tonearm movement.
2. If the switch is turned on when the motor is stationart, a start signal is generated, and is used to start up the drive circuit.
3. If the switch is turned on when the motor is rotating, the forward/reverse direction discriminator circuit will be notified of the subsequent generation of a reverse torque.
4. At the same time, a stop signal is applied to the quick-stop timing circuit.

- Quick stop timing circuit

1. The motor will rapidly stop as a result of the reverse torque generated by the stop signal.
2. When the turntable speed drops, the signal of Fig. 10-b will appear at the quick stop timing circuit (Pin 13 of PA2005).
3. As a result of this signal, the waveform at pin 14 of PA2005 will become as shown in Fig. 10-c.
4. When the motor speed falls off, the signal level at pin 14 of PA2005 will exceed the fixed value, whereupon the drive circuit will go off.
5. Subsequently, the turntable will continue to rotate under its own inertia for a brief interval and then stop.

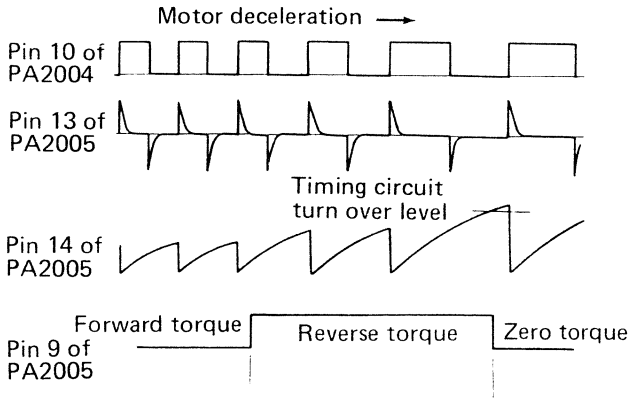


Fig. 20

• Stroboscope Pulse Circuit

1. The platter has only a single row of stroboscopic markings. Switchover for 45 and 33 rpm is effected by changing the frequency of the pulse to the stroboscopic lamp.
2. From the Frequency Divider Selector I, a frequency of either 75Hz (for 45 rpm, representing 1/80 of 6000Hz) or 55.5Hz (for 33 rpm, representing 1/108) is obtained and supplied to the transistor that drives the stroboscopic lamp.

• Reverse Rotation Prevention

1. PXM-061 operates indiscriminately in regard to the direction of rotation. If the platter is turned slowly in the reverse direction by hand, a forward torque will be applied until the platter stops, reverses its rotation and reaches rated speed in the proper direction.
2. If, however, the rotational speed in the reverse direction is in excess of 33 or 45 rpm, the Forward/Reverse Command Block may "misread" this as simply excessive speed ("overrun") and apply a reverse torque until rated speed is attained.
3. This reverse torque will further accelerate the turntable rotation in the reverse direction. This is known as "reverse run-away."
4. To prevent this from happening, a Reverse Rotation Prevention circuit has been included.
5. This Reverse Rotation Prevention circuit consists of two flip-flops and AND gates See Fig. 21.
6. The input for this circuit is derived from the Hall element position detection signals processed in the Reverse Rotation Prevention circuit.
7. As long as the platter is rotating in the proper direction, this pulse enters in the order B — A — C, and no "reverse" command is generated.
8. If, however, the platter rotates in the reverse direction, the pulse order becomes A — B — C, and a corrective command is given to the Forward/Reverse Command Circuit.

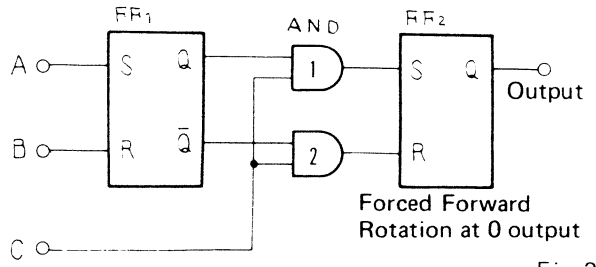


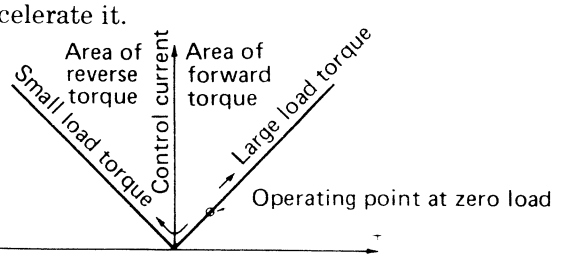
Fig. 21

		FF1				C	AND		FF2
		S	R	Q	Q̄		1out	2out	Q
Forward rotation	B	0	1	0	1	0	0	0	
	↓								
	A	1	0	1	0	0	0	0	
	↓								
	C	0	0	1	0	1	1	0	1
Reverse rotation									
	A	1	0	1	0	0	0	0	
	↓								
	B	0	1	0	1	0	0	0	
	↓								
	C	0	0	0	1	1	0	1	0

Truth table

• Comparator Control and Forward/Reverse Command Circuit

1. Two inputs are supplied to the Control Comparator: a) a 4V reference voltage from the voltage stabilizer; and b) the output from the active filters, which serves as the detection signal.
2. If the turntable rotates faster than rated speed, the detection signal is higher than the 4V reference.
3. When this happens, the Comparator Control sends a command to the Forward/Reverse Command Circuit, telling it to apply a reverse torque to the motor to slow it down.
4. Conversely, if turntable rotation is below rated speed, the detection signal voltage will be below the 4V reference.
5. In this case, the Comparator Control indicates to the Forward/Reverse Command Circuit that forward torque must be applied to the motor to accelerate it.



V18. . . Voltage at pin (18)
V19. . . Voltage at pin (19)

Fig. 22

• Drive Circuit

1. The signals employed in the switching of Q2 ~ Q7 in Fig. 23 are generated by 3 Hall elements, and applied to terminals a, b, and c via the position signal formation circuit.
2. The phase of these step waveform signals is displaced by 120° from each other.
3. When the step waveform signals at position I in Fig. 24-a are applied to the drive circuit terminals a, b, and c, the potential at terminal a will be lowered, resulting in Q2 being turned on. The potential at terminal b will be raised, resulting in Q6 being turned on, but the potential at terminal c will remain at the reference level voltage (the bias settings for Q4 and Q7 have been designed to prevent these 2 transistors from operating when a reference level voltage is applied).
4. Vcc will thus be applied across the Q2 — coil L_A — coil L_B — (2) — Q6 route, thereby producing an S polarity in L_A, and an N polarity in L_B.
5. Once the magnetic filed is generated, the rotor will commence to rotate. After the rotor turns through 20°, the signals at position II in Fig. 24-b will be applied to terminals a, b, and c, thereby resulting in a change in the flow routes of the drive currents. After the rotor turns through another 20°, the signals shown at position III in Fig. 24-c will be applied, again resulting in changes in flow routes of the drive currents. For every 20° that the rotor turns through, the flow routes for the drive currents will change as shown in Figs. 24-d, 24-e, and 24-f, finally returning to the routes shown in Fig. 19-a again.
6. A control voltage generated by the forward/reverse direction discriminator indicator circuit is applied to the control input terminal, thereby controlling the flow of current in the coils.

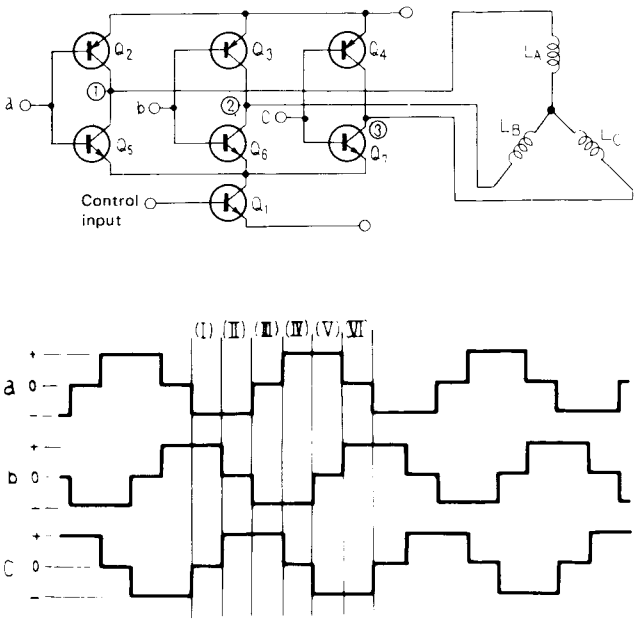
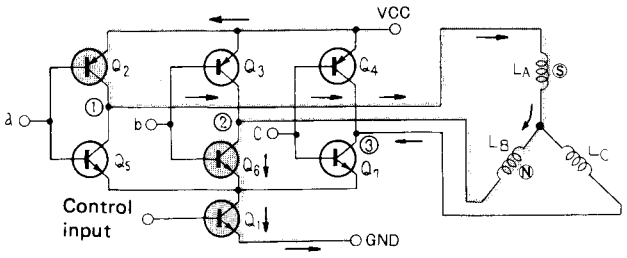


Fig. 23



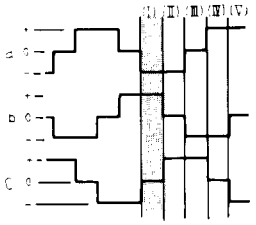
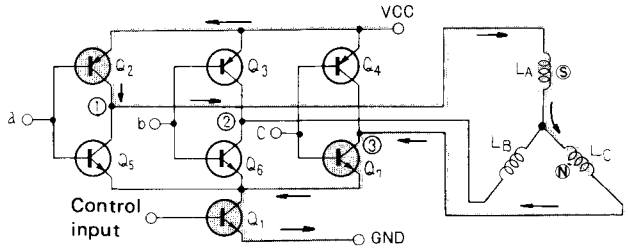


Fig. 24-a



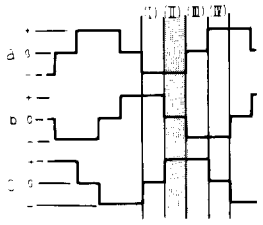
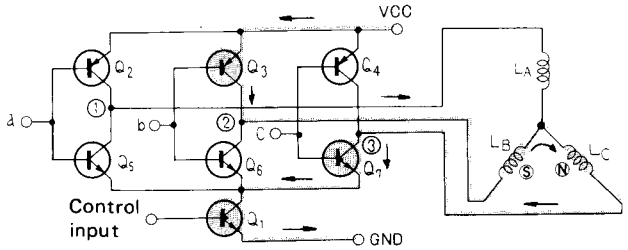


Fig. 24-b



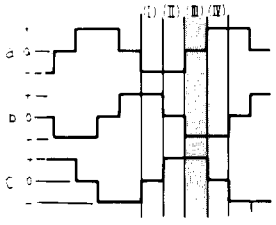
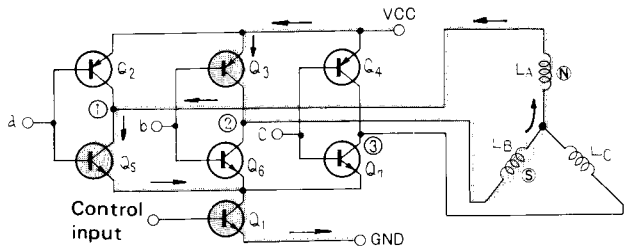


Fig. 24-c



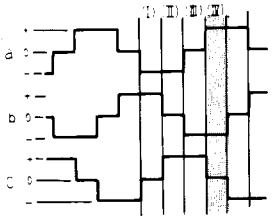
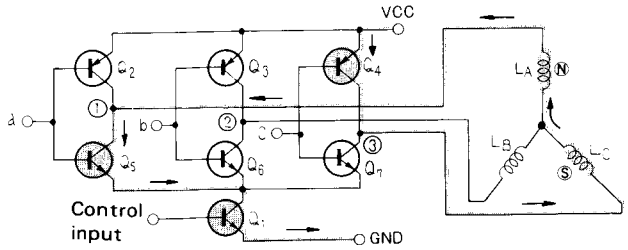


Fig. 24-d



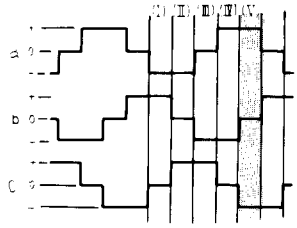
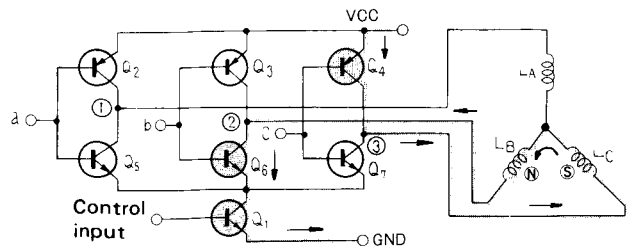


Fig. 24-e



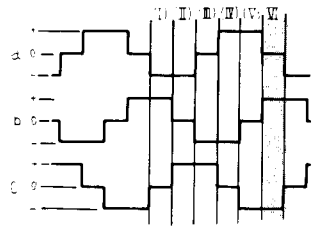


Fig. 24-f

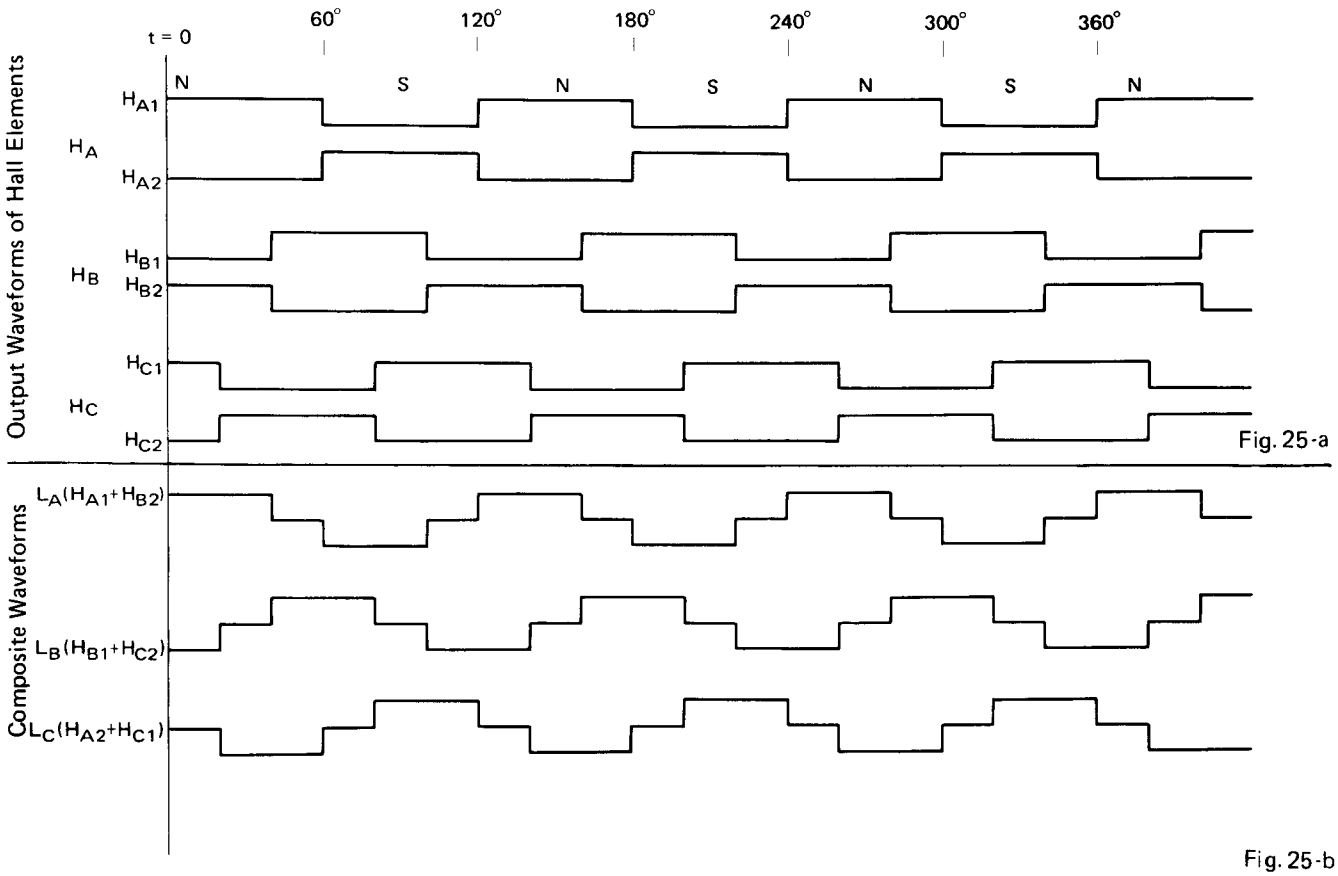


Fig. 25-a

Fig. 25-b

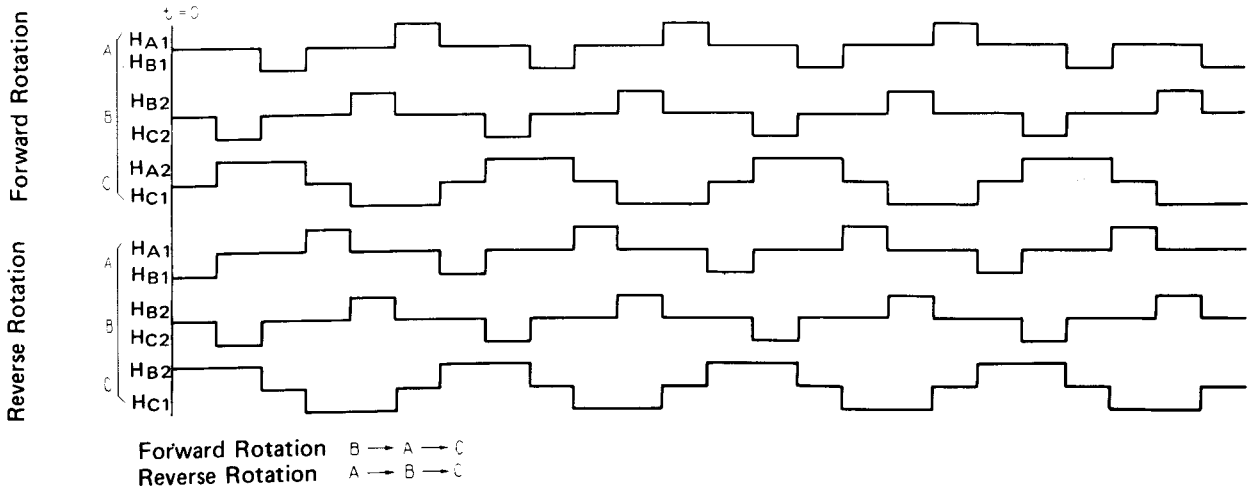
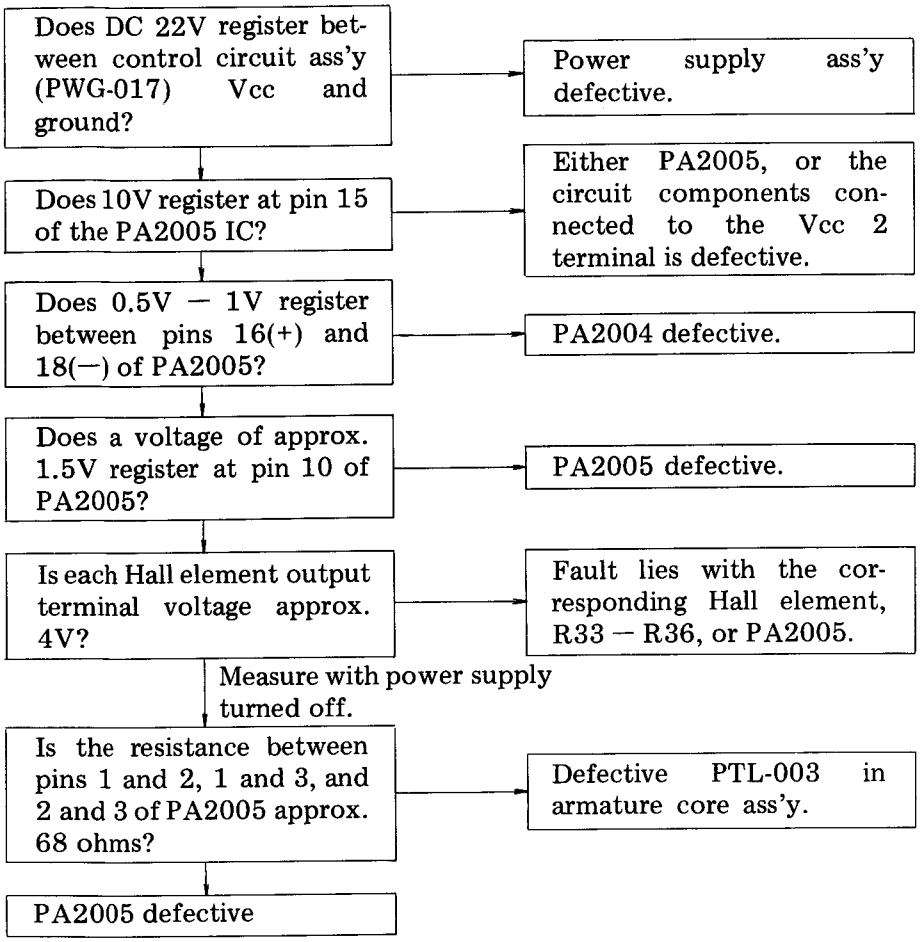


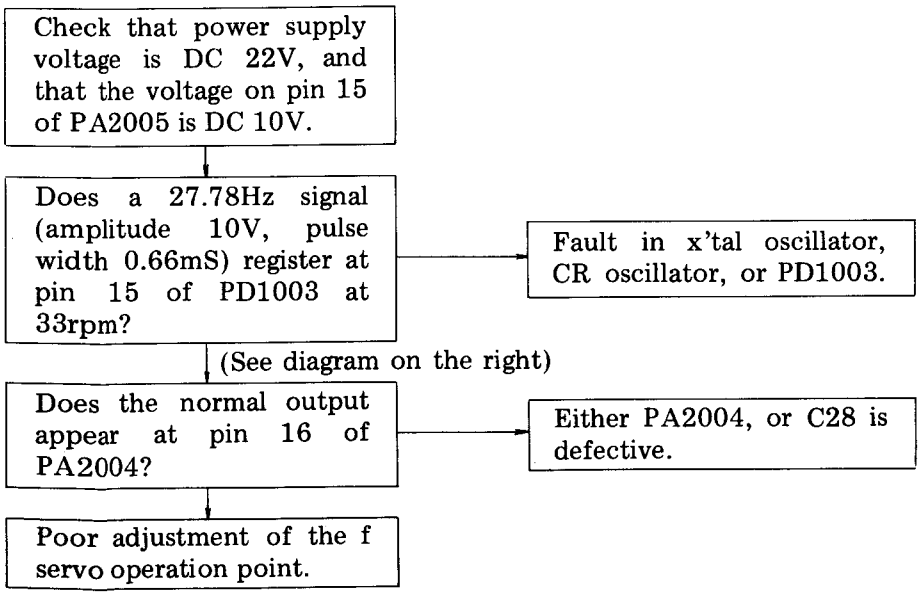
Fig. 26

9.6 TROUBLE SHOOTING CHART

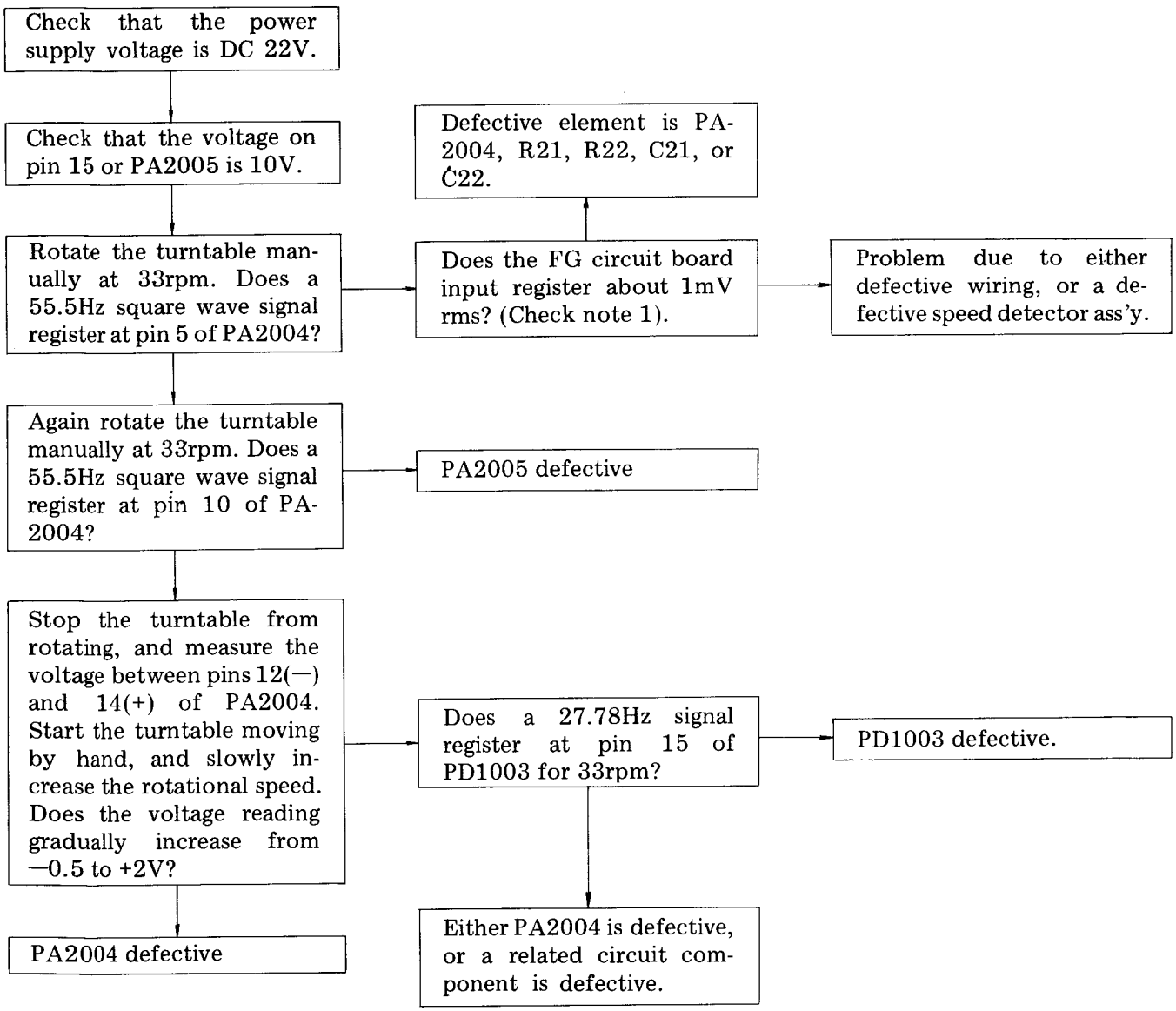
● **When Motor Fails to Rotate**


Does DC 22V register between control circuit ass'y (PWG-017) Vcc and ground?
Power supply ass'y defective.
Does 10V register at pin 15 of the PA2005 IC?
Either PA2005, or the circuit components connected to the Vcc 2 terminal is defective.
Does 0.5V — 1V register between pins 16(+) and 18(—) of PA2005?
PA2004 defective.
Does a voltage of approx. 1.5V register at pin 10 of PA2005?
PA2005 defective.
Is each Hall element output terminal voltage approx. 4V?
Fault lies with the corresponding Hall element, R33 — R36, or PA2005.
Measure with power supply turned off.
Is the resistance between pins 1 and 2, 1 and 3, and 2 and 3 of PA2005 approx. 68 ohms?
Defective PTL-003 in armature core ass'y.
PA2005 defective

● **Phase Lock Failure**

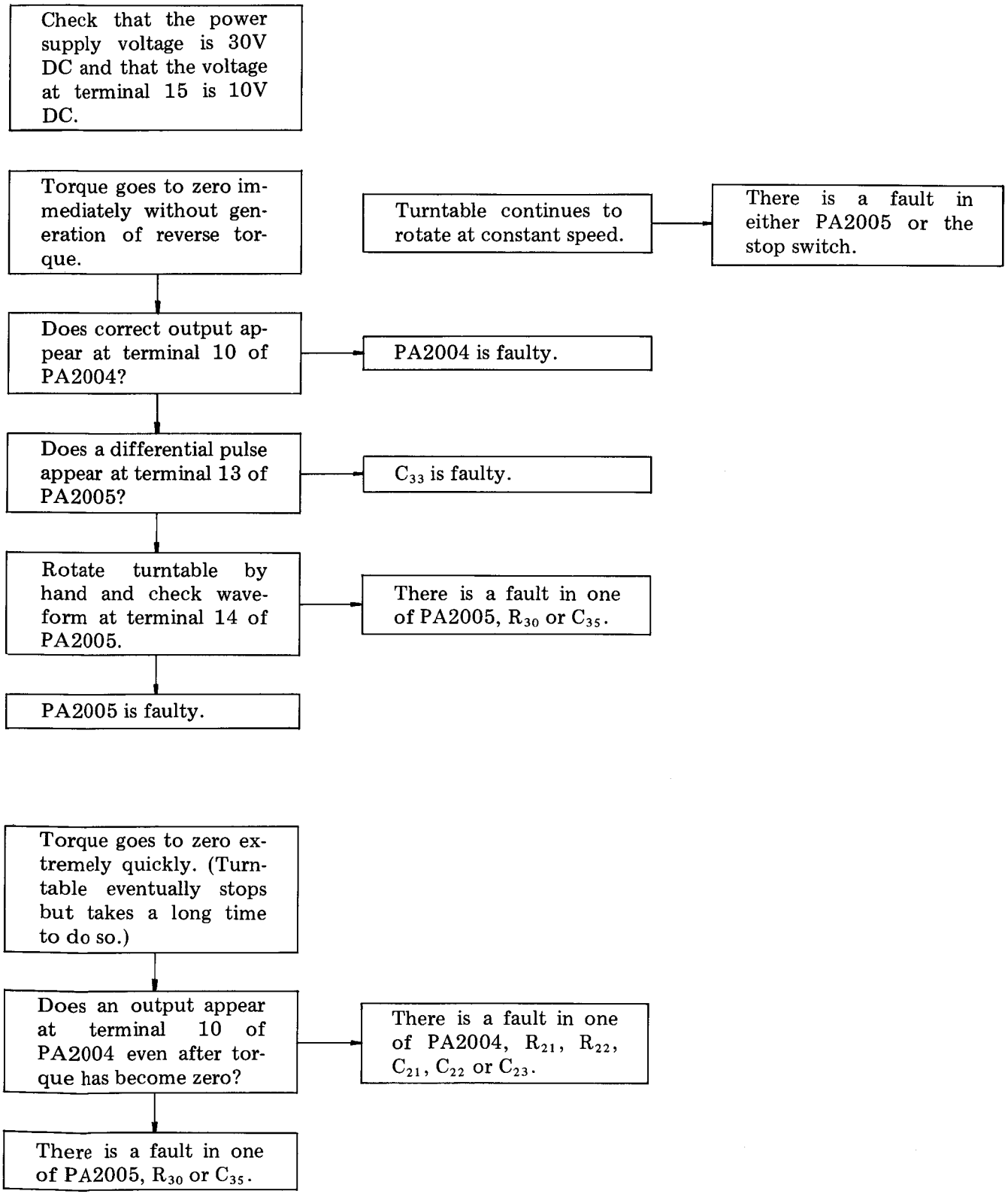

Check that power supply voltage is DC 22V, and that the voltage on pin 15 of PA2005 is DC 10V.
Does a 27.78Hz signal (amplitude 10V, pulse width 0.66mS) register at pin 15 of PD1003 at 33rpm?
Fault in x'tal oscillator, CR oscillator, or PD1003.
(See diagram on the right)
Does the normal output appear at pin 16 of PA2004?
Either PA2004, or C28 is defective.
Poor adjustment of the f servo operation point.

- **Motor Runaway**


Check that the power supply voltage is DC 22V.
Check that the voltage on pin 15 or PA2005 is 10V.
Rotate the turntable manually at 33rpm. Does a 55.5Hz square wave signal register at pin 5 of PA2004?
Does the FG circuit board input register about 1mV rms? (Check note 1).
Defective element is PA-2004, R21, R22, C21, or C22.
Problem due to either defective wiring, or a defective speed detector ass'y.
Again rotate the turntable manually at 33rpm. Does a 55.5Hz square wave signal register at pin 10 of PA-2004?
PA2005 defective
Stop the turntable from rotating, and measure the voltage between pins 12(−) and 14(+) of PA2004. Start the turntable moving by hand, and slowly increase the rotational speed. Does the voltage reading gradually increase from −0.5 to +2V?
Does a 27.78Hz signal register at pin 15 of PD1003 for 33rpm?
PD1003 defective.
PA2004 defective
Either PA2004 is defective, or a related circuit component is defective.

**Note 1. Connect a 100μV/10V capacitor between TP22 and ground.*

- **Quick stop operation faults (Stop switch ON)**


Check that the power supply voltage is 30V DC and that the voltage at terminal 15 is 10V DC.
Torque goes to zero immediately without generation of reverse torque.
Turntable continues to rotate at constant speed.
There is a fault in either PA2005 or the stop switch.
Does correct output appear at terminal 10 of PA2004?
PA2004 is faulty.
Does a differential pulse appear at terminal 13 of PA2005?
C_{33} is faulty.
Rotate turntable by hand and check waveform at terminal 14 of PA2005.
There is a fault in one of PA2005, R_{30} or C_{35}.
PA2005 is faulty.
Torque goes to zero extremely quickly. (Turntable eventually stops but takes a long time to do so.)
Does an output appear at terminal 10 of PA2004 even after torque has become zero?
There is a fault in one of PA2004, R_{21}, R_{22}, C_{21}, C_{22} or C_{23}.
There is a fault in one of PA2005, R_{30} or C_{35}.